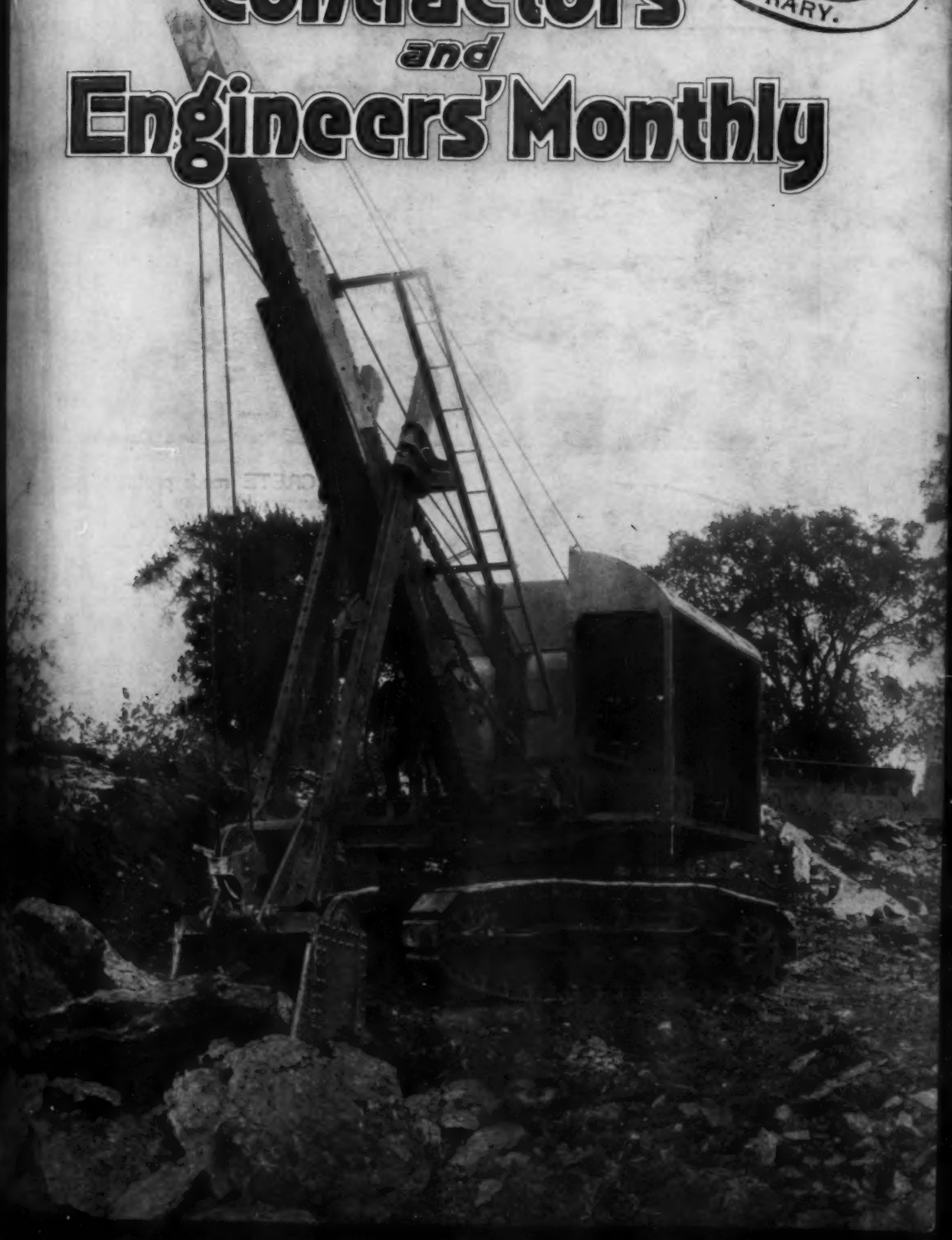
AUGUST, 1925

62

25 Cents $1 a Year

Contractors' and Engineers' Monthly



VOL. XI. No. 2 CONTRACTORS' & ENGINEERS' MONTHLY AUGUST, 1925
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Where to Purchase

A comprehensive classification of the leading machinery and supply manufacturers arranged for the convenience of contractors, engineers and public officials who may wish to secure information about construction equipment.

The Index to Advertisers faces the inside back cover. When writing to advertisers please mention the CONTRACTORS' & ENGINEERS' MONTHLY. A star (*) before the manufacturer's name indicates that his advertisement appears in this issue.

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Standard Oil Co. of Calif., San Francisco, Cal.
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Easton Car & Constn. Co. of Mo., Kansas City, Mo.

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*Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
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Central States Bridge Co., Indianapolis, Ind.
Champion Bridge Co., Wilmington, O.
Chesapeake Iron Works, Baltimore, Md.
Chicago Bridge & Iron Works, Chicago, Ill.
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Eastern Bridge & Struc. Co., Worcester, Mass.
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Fort Pitt Bridge Works, Pittsburgh, Pa.
Ingalls Iron Works Co., Birmingham, Ala.
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Penn. Bridge Co., Beaver Falls, Pa.
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Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
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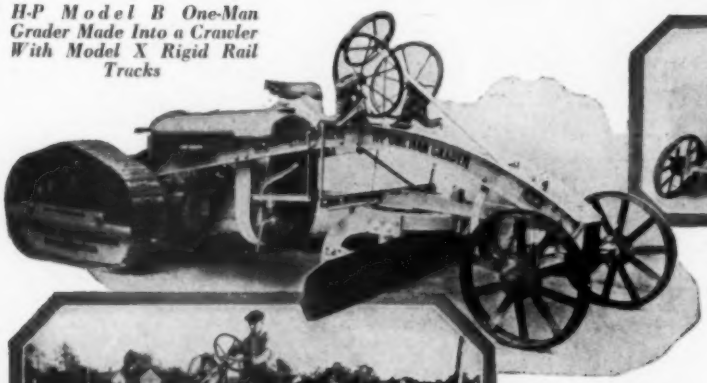
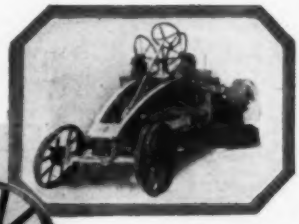
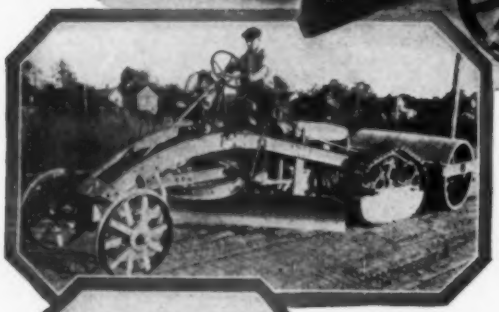
*Littleford Bros., Cincinnati, O.
Stuebner Iron Works, G. L., L. I. City, N. Y.

H-P Model B One-Man Grader Made Into a Crawler With Model X Rigid Rail Tracks





The Leaning Wheel Stops Side-Thrust and Speeds Ditching



Roller Attachment Follows Scraper on One Operation if Desired

The Rooter Shows Its Power in Tearing Up Old Pavement

Step on the Gas!

Because of flexibility, quick get-a-way, ease of turning around and other features, the Hadfield-Penfield "One-Man" Grader will make it possible for you to do more and better work on your contract and at a big saving in cost of equipment and work done. Losing contracts have often been made profitable by this outfit. Hadfield-Penfield Rigid Rail tracks give additional advantages in heavy pulling and rough going.

Here are some of the features which make these appliances cut cost and increase accomplishments:

Scarifying, scraping and rolling can be done in one operation.

H. P. Rigid Rail Tracks turn Fordsons into a more powerful, Crawler type, tractor.

Leaning wheel gives extra efficiency in ditching.

Reversible rooter is self-sharpening.

Scarifier teeth special steel, double pointed, reversible.

Automatic power control.

Either Central or Rear End Drive.

In winter it is most practical snow remover known, speeding up the work and lessening the cost.

For Rooting, Scarifying, Grading, Ditching, Scraping, Backfilling, Rolling and all operations in road building and road patrol the Hadfield-Penfield units are marvels of speed and economy.

The Hadfield-Penfield Steel Co.

Bucyrus, Ohio

RIGID RAIL TRACKS — HADFIELD PENFIELD — ONE MAN GRADER

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- *Mead-Morrison Mfg. Co., E. Boston, Mass.
- Brown Hoisting Mchy. Co., Cleveland, O.
- Browning Co., Cleveland, O.
- Erie Steel Const'n Co., Erie, Pa.
- Coleman Co., F. A., Cleveland, O.
- Hayward Co., New York.
- Industrial Works, Bay City, Mich.
- Link-Belt Co., Chicago, Ill.
- McMyler Interstate Co., Cleveland, Ohio
- Orton & Steinbrenner Co., Chicago, Ill.
- Owen Bucket Co., Cleveland, Ohio.
- Williams Co., G. H., Erie, Pa.

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- *Smith Co., T. L., Milwaukee, Wis.
- Insley Mfg. Co., Indianapolis, Ind.
- Ransome Concrete Mchy. Co., Dunellen, N. J.
- Union Iron Works, Inc., Hoboken, N. J.

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- *Sauerman Bros., Chicago, Ill.
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- Page Engineering Co., Chicago, Ill.

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- *Mead-Morrison Mfg. Co., E. Boston, Mass.
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- Browning Co., Cleveland, O.
- Hayward Co., New York.
- Owen Bucket Co., Cleveland, Ohio.
- Williams Co., G. H., Erie, Pa.

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- McMyler Interstate Co., Cleveland, O.
- Orton & Steinbrenner Co., Chicago, Ill.

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- Sargent & Co., New Haven, Conn.
- Stanley Works, New Britain, Conn.
- Yale & Towne Mfg. Co., Stamford, Conn.

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- Haggard & Marcusson Co., Chicago, Ill.
- Southern Rome Co., Baltimore, Md.

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- Waterbury Co., New York.

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- Birmingham Tank Co., Birmingham, Ala.
- Foundation Co., New York.
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- Petroleum Iron Works Co., Sharon, Pa.

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- Carbide Calcium Co., Carbondale, Pa.

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- Economy Baler Co., Ann Arbobr, Mich.
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- Steel Basket Co., Cedar Rapids, Iowa.

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- Atlas Car & Mfg. Co., Cleveland, O.
- Austin Machinery Corp'n, Muskegon, Mich.
- Chase Fdry. & Mfg. Co., Columbus, O.
- Easton Car & Const'n Co., Easton, Pa.
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- Stuebner Iron Works, G. L., L. I. City, N. Y.
- United Iron Works, Inc., Kansas City, Mo.
- Weller Mfg. Co., Chicago, Ill.
- Whiting Corp., Harvey, Ill.

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- Akron Barrow Co., Cleveland, Ohio.
- Etnyre & Co., E. D. Oregon, Ill.
- Gray Iron Fdry. Co., Reading, Pa.
- Lee Trailer & Body Co., Chicago, Ill.
- Ransome Concrete Mchy. Co., Dunellen, N. J.
- Toledo Wheelbarrow Co., Toledo, Ohio.

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- Canton Foundry & Machine Co., Canton, O.
- Casey-Hedges Co., Chattanooga, Tenn
- Clow & Sons, J. B., Chicago, Ill.
- Dee Co., W. K., Chicago, Ill.
- Elkhart Fdry. & Mach. Co., Elkhart, Ind.
- Foundry Mfg. Co., St. Albans, Vt.
- Gilbert Mfg. Co., Aberdeen, S. Dak.
- Klauer Mfg. Co., Dubuque, Iowa.
- Madison Foundry Co., Cleveland, O.
- Pechstein Iron Works, Keokuk, Ia.
- Portable Machinery Co., Passaic, N. J.
- Sessions Foundry Co., Bristol, Conn.
- South Bend Foundry Co., South Bend, Ind.

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- Elgin Sales Corp., New York.

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- Ingersoll-Rand Co., New York.
- Mueller Company, Decatur, Ill.

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Milwaukee Corrugating Co., Milwaukee, Wis.
Wheeling Corrugating Co., Wheeling, W. Va.

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Allentown Portland Cement Co., Allentown, Pa.
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Giant Portland Cement Co., Philadelphia, Pa.
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Golden State Portland Cement Co., Los Angeles, Cal.
Great West'n Port. Cem. Co., Kansas City, Mo.
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Helderberg Cement Co., Albany, N. Y.
Hercules Cement Corp., Philadelphia, Pa.
Hermitage Portland Cement Co., Nashville, Tenn.
Huron Portland Cement Co., Detroit, Mich.
Indiana Portland Cement Co., Indianapolis, Ind.
International Cement Corpn., New York.
International Portland Cement Co., Ltd., Spokane, Wash.
Kansas Portland Cement Co., Kansas City, Mo.
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Kosmos Portland Cement Co., Louisville, Ky.
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Lehigh Portland Cement Co., Allentown, Pa.
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Manitowoc Portland Cement Co., Manitowoc, Wis.
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Monolith Portland Cement Co., Los Angeles, Cal.
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Nebraska Cement Co., Denver, Colo.
Newago Portland Cement Co., Newago, Mich.
New Egyptian Portland Cement Co., Fenton, Mich.
Northwestern States Portland Cement Co., Mason City, Ia.
Ogden Portland Cement Co., Ogden, Utah.
Oklahoma Portland Cement Co., Denver, Colo.
Olympic Portl'd Cement Co., Ltd., Seattle, Wash.
Oregon Portland Cement Co., Portland, Ore.
Pacific Portland Cement Co., San Francisco, Cal.
Peerless Portland Cement Co., Union City, Mich.
Peninsular Portland Cement Co., Cement City, Mich.
Penn-Allen Cement Co., Allentown, Pa.
Petoskey Portland Cement Co., Petoskey, Mich.
Phoenix Portland Cement Co., Nazareth, Pa.
Portland Cement Co. of Utah, Salt Lake City, Utah.
Pyramid Portland Cement Co., Des Moines, Ia.
Riverside Portl'd Cement Co., Los Angeles, Cal.
San Antonio Portland Cement Co., San Antonio, Tex.
Sandusky Cement Co., Cleveland, Ohio.
Santa Cruz Portland Cement Co., San Francisco, Cal.
Security Cement and Lime Co., Hagerstown, Md.
Signal Mountain Portland Cement Co., Chattanooga, Tenn.
Southern States Portland Cement Co., Rockport, Ga.
Southwest'n Portland Cement Co., El Paso, Tex.
Sun Portland Cement Co., Portland, Ore.
Superior Portland Cement Co., Seattle, Wash.
Texas Portland Cement Co., Dallas, Tex.
Three Forks Portland Cement Co., Denver, Colo.
Tidewater Portland Cement Co., Baltimore, Md.
Trinity Portland Cement Co., Dallas, Tex.
Union Portland Cement Co., Ogden, Utah.
U. S. Portland Cement Co., Denver, Colo.
Universal Portland Cement Co., Chicago, Ill.
Vulcanite Portland Cement Co., Philadelphia, Pa
Wabash Portland Cement Co., Detroit, Mich.
Wolverine Portl'd Cement Co., Coldwater, Mich
Wyandotte Portland Cement Co., Detroit, Mich

CEMENT GUNS

Cement Gun Co., Allentown, Pa.

CEMENT INSPECTION (See Inspecting Laboratories)

CEMENT TOOLS

Abrams Cement Tool Co., Detroit, Mich.

CENTRIFUGAL PUMPS

(See "Pumps, Centrifugal")

CHAINS

American Chain Co., Inc., Bridgeport, Conn.
Chain Belt Co., Milwaukee, Wis.
Columbus McKinnon Chain Co., Columbus, O.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
U. S. Chain & Forge Co., Pittsburgh, Pa.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

CHEMICALS FOR WATER PURIFICATION

Arnold, Hoffman & Co., Inc., New York.
Du Pont de Nemours & Co., E. I., Wilmington, Del.
Electro Bleaching Gas Co., New York.
General Chemical Co., New York.
Hooker Electrochemical Co., New York.
Mathieson Alkali Works, Inc., New York.
Penna. Salt Mfg. Co., Philadelphia, Pa.

CHIMNEYS, CONCRETE

Heine Chimney Co., Chicago, Ill.
Rust Engineering Co., Pittsburgh, Pa.
Weber Chimney Co., Chicago, Ill.

CHIMNEYS, RADIAL BRICK

American Chimney Corp., New York.
Alphons Custodis Chimney Const. Co., New York
Heine Chimney Co., Chicago, Ill.
Heinicke, Inc., H. R., Indianapolis, Ind.
Kellogg & Co., M. W., New York.
Rust Engineering Co., Pittsburgh, Pa.

CHIMNEYS, STEEL (See Stacks, Steel)

CHLORINATORS

*Wallace & Tiernan Co., Inc., Newark, N. J.
Paradon Eng. Co., Long Island City, N. Y.

CHLORINE, LIQUID (See Liquid Chlorine)

CHUTES, CONCRETE

*Insley Mfg. Co., Indianapolis, Ind.
*Lakewood Engineering Co., Cleveland, O.
Ransome Concrete Mchy. Co., Dunellen, N. J.

CLIPS, WIRE ROPE

American Hoist & Derrick Co., St. Paul, Minn.
Fischer & Hayes Rope & Steel Co., Chicago, Ill.
Marion Malleable Iron Works, Marion, Ind.
Mockbee & Co., C. M., Cincinnati, O.
John A. Roebling Sons Co., Trenton, N. J.
Upson-Walton Co., Cleveland, O.

COAL AND ORE CONVEYING MACHINERY

*Barber-Greene Co., Aurora, Ill.
*Good Roads Mach'y Co., Kennett Square, Pa.

*Haiss Mfg. Co., Geo., New York.
*Lidgerwood Manufacturing Co., New York
*Mead-Morrison Mfg. Co., E. Boston, Mass.
Bartlett & Snow Co., C. O. Cleveland, Ohio.
Brown Hoisting Mchy. Co., Cleveland, O.
Chain Belt Co., Milwaukee, Wis.
Fairfield Engineering Co., Marion, Ohio
Gifford-Wood Co., Hudson, N. Y.
Green, L. P., Chicago, Ill.
Hunt Co., Inc., C. W., West New Brighton, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Kon-Wald Co., Buffalo, N. Y.
Link-Belt Co., Chicago, Ill.
Portable Machinery Co., Passaic, N. J.
Robins Conv. Belt Co., New York
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

COCKS, CURB AND CORPORATION

*Union Water Meter Co., Worcester, Mass.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Glauber Brass Mfg. Co., Cleveland, Ohio.
Haydenville Co., Haydenville, Mass.
Mueller Company, Decatur, Ill.

COLLAPSIBLE HORSES

*Taylor Collapsible Horse Co., Chicago, Ill.

COLUMN CLAMPS

*Insley Mfg. Co., Indianapolis, Ind.
*Sterling Wheelbarrow Co., Milwaukee, Wis.
*Universal Form Clamp Co., Chicago, Ill.
The O. D. G. Co., Owensboro, Ky.
Phillips, Co., Victor L., Kansas City, Mo.
Symons Clamp & Mfg. Co., Chicago, Ill.

COMPRESSORS, AIR (See Air Compressors)

CONCRETE FLOOR HARDENER

Anti-Hydro Waterproofing Co., Newark, N. J.
General Chemical Co., New York.
General Fireproofing Co., Youngstown, Ohio.
Granitex Corp., New York.
Horn Co., A. C., Long Island City, N. Y.
Master Builders Co., Cleveland, O.
Sonneborn Sons, Inc., L., N. Y. "Lapidolith"
Truscon Laboratories, Detroit, Mich.

CONCRETE HEATERS

*Aeroil Burner Co., Union Hill, N. J.

CONCRETE MIXERS

*American Cement Mchy. Co., Inc., Keokuk, Ia.
*Atlas Eng. Co., Milwaukee, Wis.
*Construction Mchy. Co., Waterloo, Iowa
*Industrial Plants Corp'n, Toledo, O.
*Jaeger Machine Co., Columbus, O.
*Koehring Co., Milwaukee, Wis.
*Kwik-Mix Concrete Mixer Co., Port Washington, Wis.
*Lakewood Engineering Co., Cleveland, O.
*Marsh-Capron Co., Chicago, Ill.
*Raber & Lang Mfg. Co., Kendallville, Ind.
*Smith Co., T. L., Milwaukee, Wis.
Anchor Mfg. Co., Chicago, Ill.
Badger Concrete Mixer Co., Milwaukee, Wis.
Chain Belt Co., Milwaukee, Wis.
Contractors' Equipment Co., Keokuk, Ia.
B. M. Cropp Co., Chicago, Ill.
Foote Concrete Mchy. Co., Chicago, Ill.
Gray Iron Fdry Co., Reading, Pa.
Judy Mfg. Co., Centerville, Ia.
Knickerbocker Co., Jackson, Mich.
Lansing Co., Lansing, Mich.
Leach Co., Oshkosh, Wis.
Milwaukee Concrete Mixer Co., Milwaukee, Wis.
Ransome Concrete Mchy. Co., Dunellen, N. J.
Republic Iron Works, Tecumseh, Mich.
Schramm, Inc., West Chester, Pa.
Standard Scale & Supply Co., Pittsburgh, Pa.
Truckmixer Co., Milwaukee, Wis.
Worthington Pump & Mach'y Corp., New York.

CONCRETE PILING. (See Piling, Concrete)

CONCRETE PIPE (See Pipe, Reinforced Concrete)

CONCRETE REINFORCEMENT

*Truscon Steel Co., Youngstown O.
*Wickwire Spencer Steel Co., Inc., New York
American Steel & Wire Co., Chicago, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Concrete Steel Co., New York.
Consolidated Expanded Metal Co., Braddock, Pa.
Electric Welding Co., Pittsburgh, Pa.
General Fireproofing Co., Youngstown, O.
Inland Steel Co., Chicago, Ill.
Kalman Steel Co., Chicago, Ill.
Laclede Steel Co., St. Louis, Mo.
National Steel Fabric Co., Pittsburgh, Pa.
Ryerson & Son, J. T., Chicago, Ill.
Youngstown Pressed Steel Co., Warren, O.
Youngstown Sheet & Tube Co., Youngstown, O.

CONCRETE ROAD FINISHERS

*French & Co., A. W., Chicago, Ill.
*Heltzel Steel Form & Iron Co., Warren, O.
*Lakewood Engineering Co., Cleveland, O.
Dunn Road Mach. Co., Conneaut, Ohio.

CONCRETE SURFACING MACHINES

*Concrete Surfacing Machy. Corp., Cincinnati, O.

CONCRETE TOOLS

*Dallett Co., The, Philadelphia, Pa.

CONDENSERS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Dean Bros. Co., Indianapolis, Ind.
Ingersoll-Rand Co., New York.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Wheeler Condenser & Eng. Co., Carteret, N. J.
Worthington Pump & Mach'y Corp., New York

CONDUIT RODS

Bissell Co., F., Toledo, Ohio.
Turbine Sewer Machine Co., Milwaukee, Wis.
Waldo Bros. & Bond Co., Boston, Mass.

CONDUITS, UNDERGROUND

American Vitrified Products Co., Akron, Ohio.
Johns-Manville Inc., New York
National Fireproofing Co., New York.
Ric-wiL Co., Cleveland, O.

CONTRACTORS' SUPPLY DEALERS
(See pages 123-141)

CONVEYORS, BELT

*Austin-Western Rd. Mach'y Co., Chicago, Ill.
*Barber-Greene Co., Aurora, Ill.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Chain Belt Co., Milwaukee, Wis.
Gifford Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Olson & Co., Sam'l, Chicago, Ill.
Portable Machinery Co., Passaic, N. J.
Robins Conv. Belt Co., New York.
Standard Conveyor Co., No. St. Paul, Minn.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

CONVEYORS, BUCKET

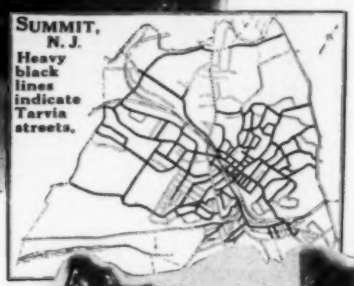
*Atlas Engineering Co., Milwaukee, Wis.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Mead-Morrison Mfg. Co., E. Boston, Mass.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Bartlett & Snow Co., C. O., Cleveland, O.
Caldwell & Son, H. W., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Fairfield Engineering Co., Marion, Ohio
Gifford Wood Co., Hudson, N. Y.
Godfrey Conveyor Co., Elkhart, Ind.
Guarantee Constn. Co., New York.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Olson & Co., Sam'l, Chicago, Ill.
Republic Rubber Co., Youngstown, O.
Robins Conv. Belt Co., New York.
Stephens Adamson Mfg. Co., Aurora, Ill.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

CONVEYORS, GRAVITY

Dow Co., Louisville, Ky.
Lamson Co., Syracuse, N. Y.
Mathews Gravity Carrier Co., Elwood City, Pa.
Standard Conveyor Co., No. St. Paul, Minn.

COUPLINGS, HOSE

Cleveland Pneumatic Tool Co., Cleveland, O.
Ingersoll-Rand Co., New York.



Once a Tarvia-Town always a Tarvia-Town—

HERE'S a significant fact: "Repeat orders make up the bulk of Tarvia business!"

Many cities, towns, states and counties have been steady users of Tarvia over a period of ten to twenty years or more. And in those places we are apt to find the same road officials in office who were "in" when the Tarvia program was inaugurated.

What is the reason for this enduring satisfaction with a Tarvia program? The roads themselves. Many of the old pavements, built in the years when automobiles were snorting novelties, are still in perfect condition today—still as smooth, mudless, dustless and skid-proof as the day they were built.

Note: The experience of hundreds of road officials has proved that only the most economical maintenance is necessary to make a Tarvia pavement last indefinitely.

Tarvia Service *Chapter VIII*

Summit, New Jersey, is a typical Tarvia-Town. In 1914, Summit first began using Tarvia. Now there are 30 miles of mudless, dustless, all-year Tarvia streets within the city limits.

The Barrett Company

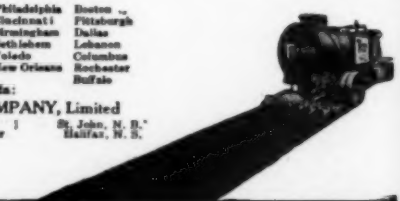
New York	Chicago	Philadelphia	Boston
St. Louis	Cleveland	Cincinnati	Pittsburgh
Detroit	Kansas City	Birmingham	Dallas
Minneapolis	Salt Lake City	Bethlehem	Lebanon
Youngstown	Milwaukee	Toledo	Columbus
Baltimore	Syracuse	New Orleans	Rochester
Providence			Buffalo

In Canada:

THE BARRETT COMPANY, Limited

Montreal	Toronto	St. John, N. B.
Winnipeg	Vancouver	Halifax, N. S.

Tarvia
For Road Construction Repair and Maintenance



CRANES, LOCOMOTIVE

*Bay City Dredge Wks., Bay City, Mich.
*Byers Machine Co., Ravenna, O.
*Harnischfeger Corp., Milwaukee, Wis.
*Koehring Co., Milwaukee, Wis.
*Osgood Co., The, Marion, O.
*Thew Shovel Co., Lorain, O.
American Hoist & Derrick Co., St. Paul, Minn.
Brown Hoisting Mchy. Co., Cleveland, O.
Browning Co., Cleveland, O.
Bucyrus Co., South Milwaukee, Wis.
Davenport Locomotive Works, Davenport, Ia.
Erie Steam Shovel Co., Erie, Pa.
Hanna Eng. Works, Chicago, Ill.
Industrial Works, Bay City, Mich.
Link-Belt Co., Chicago, Ill.
Locomotive Crane Co. of America, Champaign, Ill.
Marion Steam Shovel Co., Marion, O.
McMyler Interstate Co., Cleveland, O.
Northwest Engineering Works, Chicago, Ill.
Orton & Steinbrenner Co., Chicago, Ill.
Ohio Locomotive Crane Co., Bucyrus, O.
U. S. Crane Co., Chicago, Ill.

CRANES, OVERHEAD TRAVELING

*Curtis Pneumatic Mchy. Co., St. Louis, Mo.
*Harnischfeger Corp., Milwaukee, Wis.
*Industrial Plants Corp'n, Toledo, O.
Alliance Machine Co., Alliance, O.
Chesapeake Iron Wks., Baltimore, Md.
Chisholm-Moore Mfg. Co., Cleveland, Ohio.
Milwaukee Electric Crane Co., Milwaukee, Wis.
Morgan Engineering Co., Alliance, O.
Northern Eng. Works, Detroit, Mich.
Shaw Crane Works, Muskegon, Mich.
Shepard Elec. Cr. & Hst. Co., Montour Falls, N.Y.
Toledo Crane Co., Bucyrus, O.
Whiting Fdry. & Equip. Co., Harvey, Ill.

CRANES, TRUCK

*Byers Machine Co., Ravenna, Ohio
*Harnischfeger Corp., Milwaukee, Wis.
*Industrial Plants Corp'n, Toledo, O.
Bay City Fdry. & Mach. Co., Bay City, Mich.
Universal Crane Co., Cleveland, Ohio

CRANES, WRECKING

Bucyrus Co., South Milwaukee, Wis.
Industrial Works, Bay City, Mich.

CREOSOTED BLOCKS, TIMBER, ETC.

American Creosoting Co., Inc., New York.
American Creosote Works, Inc., N. Orleans, La.
Carter Bloxonend Flooring Co., Kansas City, Mo.
Colonial Creosoting Co., Inc., New York.
Creosoted Materials Co., New Orleans, La.
Georgia Creosoting Co., New York.
Jennison-Wright Co., Toledo, O.
Midland Creosoting Co., Granite City, Ill.
Republic Creosoting Co., Indianapolis, Ind.
Southern Wood Pres. Co., Atlanta, Ga.
Wyckoff Pipe & Creosoting Co., New York.

CREOSOTING AND CREOSOTING OILS

*Barrett Co., New York
Am. Creosote Wks., Inc., New Orleans, La.
American Tar Products Co., Chicago, Ill.
Jennison-Wright Co., Toledo, O.
Southern Creosoting Co., Ltd., Slidell, La.
Southern Paving Const. Co., Chattanooga, Tenn.
Wyckoff Pipe & Creosoting Co., New York.

CRUSHERS, HEAVY DUTY

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Buchanan Co., O. G., New York.
Traylor Eng. & Mfg. Co., Allentown, Pa.

CRUSHERS, ROCK

*Acme Road Machy. Co., Frankfort, N. Y.
*Austin-Western Road Mach. Co., Chicago, Ill.
*Good Roads Machy. Co., Kennett Square, Pa.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Universal Road Machinery Co., Kingston, N. Y.
Galion Iron Works & Mfg. Co., Galion, Ohio
Morgan Engineering Co., Alliance, O.
New Holland Mach. Co., New Holland, Pa.
Smith Eng. Wks., Milwaukee, Wis.
Sturtevant Mill Co., Boston, Mass.
Universal Crusher Co., Cedar Rapids, Ia.

CULVERTS, CAST IRON

*U. S. C. I. Pipe & Fdry. Co., Burlington, N. J.
American Cast Iron Pipe Co., Birmingham, Ala.
Gilbert Mfg. Co., Aberdeen, S. D.
Wood & Co., R. D., Philadelphia, Pa.

CULVERTS, CORRUGATED METAL

*Austin-Western Rd. Mach. Co., Chicago, Ill.
*Good Roads Machinery Co., Kennett Square, Pa
*Newport Culvert Co., Newport, Ky.
Canton Culvert & Silo Co., Canton, O.
Florida Metal Products Co., Jacksonville, Fla.
Galion Iron Works & Mfg. Co., Galion, Ohio
Gilbert Mfg. Co., Aberdeen, S. D.
Hardesty Mfg. Co., The R., Denver, Colo.
Klauer Mfg. Co., Dubuque, Ia.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn
Northfield Iron Co., Northfield, Minn.
Southern Metal Culvert Co., Salisbury, N. C.
Wheeling Corrugating Co., Wheeling, W. Va.

CULVERT FORMS

Concrete Form Co., Inc., Syracuse, N. Y.
Northfield Iron Co., Northfield, Minn.

CURB BOXES

*Clark Co., H. W., Mattoon, Ill.
Casey-Hedges Co., Chattanooga, Tenn.
Clow & Sons, J. B., Chicago, Ill.
Madison Foundry Co., Cleveland, O.
Mueller Co., Decatur, Ill.

CURB GUARDS, STEEL

*Godwin Co., W. S., Baltimore, Md.

CURB, STEEL PROTECTED

*Truscon Steel Co., Youngstown, O.
Concrete Steel Co., New York.
Steel Protected Concrete Co., Philadelphia, Pa

CURING OF CONCRETE

*Dow Chemical Co., Midland, Mich.
*Solvay Process Co., New York

CUTTERS, PIPE, HAND

Armstrong Mfg. Co., Bridgeport, Conn.
Barnes Tool Co., New Haven, Conn.
Erie Tool Works, Erie, Pa.
Greenfield Tap & Die Corp'n., Greenfield, Mass
Oswego Tool Co., Oswego, N. Y.
Reed Mfg. Co., Erie, Pa.
Walworth Mfg. Co., Boston, Mass.

CUTTERS, ROD AND WIRE

*Koehring Co., Milwaukee, Wis.
Buffalo Forge Co., Buffalo, N. Y.
Carolus Mfg. Co., Sterling, Ill.
Helwig Mfg. Co., St. Paul, Minn.
Worthington Pump & Mchy. Corp., New York.

CUTTING EDGES

*Adams & Co., J. D., Indianapolis, Ind.
Shunk Mfg. Co., Bucyrus, O.

CUTTING AND WELDING APPARATUS

*Milburn Co., Alexander, Baltimore, Md.
MacLeod Co., Cincinnati, O.

DERRICKS, GUY AND STIFF-LEG

*Clyde Iron Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
*Flory Mfg. Co., S., Bangor, Pa.
*Insley Mfg. Co., Indianapolis, Ind.
*Lidgerwood Manufacturing Co., New York
*Sasgen Derrick Co., Chicago, Ill.
American Hoist & Derrick Co., St. Paul, Minn.
Federal Bridge & Struc. Co., Waukesha, Wis.
Horton Co., John T., New York.
Lakeside Bridge & Steel Co., N. Milwaukee, Wis
National Hoisting Engine Co., Harrison, N. J.
Superior Iron Works, Superior, Wis.

DERRICKS, PIPE LAYING

*Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
*Lidgerwood Manufacturing Co., New York
Austin Machinery Corp'n, Muskegon, Mich.
Mueller Co., Decatur, Ill.

DERRICKS, REVOLVING

*Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
*Clyde Iron Wks. Sales Co., Duluth, Minn.
*Lidgerwood Manufacturing Co., New York

DERRICKS, STEEL

*Clyde Iron Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
*Insley Mfg. Co., Indianapolis, Ind.
*Lidgerwood Manufacturing Co., New York
American Hoist & Derrick Co., St. Paul, Minn.
Hayward Co., New York.
Lakeside Bridge & Steel Co., N. Milwaukee, Wis.
Taylor Portable Steel Derrick Co., Chicago, Ill.

DERRICKS, STEEL PORTABLE

*Clyde Iron Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
*Lidgerwood Manufacturing Co., New York
American Hoist & Derrick Co., St. Paul, Minn.

DERRICKS, TRAVELING

*Bay City Dredge Works, Bay City, Mich.
*Clyde Iron Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
American Hoist & Derrick Co., St. Paul, Minn.
Austin Machinery Corp'n, Muskegon, Mich.
Hayward Co., New York.
Nat'l Hoisting Engine Co., Harrison, N. J.
Orton & Steinbrenner Co., Chicago, Ill.

DERRICK FITTINGS

*S. Flory Mfg. Co., Bangor, Pa.
*Lidgerwood Mfg. Co., New York

DIESEL ENGINES. (See Engines, Oil)

DISTRIBUTORS, TAR AND ASPHALT

*Kinney Mfg. Co., Boston, Mass.

DISTRIBUTING PLANTS, CONCRETE

*Archer Iron Works, Chicago, Ill.
*Lakewood Engineering Co., Cleveland, O.
*Insley Mfg. Co., Indianapolis, Ind.
Ransome Concrete Mchy. Co., Dunellen, N. J.

DITCHING MACHINES. (See Excavators, Ditch and Trench)

DIVIDING PLATES (ROAD)

*Godwin Co., W. S., Baltimore, Md.

DOORS AND SHUTTERS, STEEL ROLLING

Cornell Iron Works, Inc., New York.
Kinnear Mfg. Co., Columbus, O.
Variety Fire Door Co., Chicago, Ill.
Wilson Corp., J. G., New York.

DRAFTING MACHINES

Universal Drafting Machine Co., Cleveland. O.

DRAINAGE TOOLS

*Oliver Ames & Sons Corp., North Easton, Mass.
*Ames Shovel & Tool Co., Boston, Mass.
*Geo. Griffiths Co., Cheltenham, Pa.
*The H. M. Myers Co., Beaver Falls, Pa.
*T. Rowland's Sons, Inc., Cheltenham, Pa.
*St. Louis Shovel Co., Plant, St. Louis, Mo.
*Wright Shovel Co., Anderson, Ind.

DREDGES

*Bay City Dredge Works, Bay City, Mich.
*Lidgerwood Manufacturing Co., New York
*Michigan Dredge Co., Bay City, Mich.
*Osgood Co., The, Marion, O.
American Steel Dredge Co., Fort Wayne, Ind.
Bucyrus Co., South Milwaukee, Wis.
Ellicott Machine Corp'n, Baltimore, Md.
Erie Steam Shovel Co., Erie, Pa.
Hayward Co., New York.
Marion Steam Shovel Co., Marion, O.
Stockton Iron Works, Stockton, Cal.
Street Bros. Machine Works, Chattanooga, Tenn.
Superior Iron Works, Superior, Wis.

DREDGES, DIPPER

*Bay City Dredge Works, Bay City, Mich.
*Osgood Co., Marion, O.
American Steel Dredge Co., Fort Wayne, Ind.
Austin Machinery Corp'n, Muskegon, Mich.
Bucyrus Co., South Milwaukee, Wis.
Fairbanks Steam Shovel Co., Marion, O.
Marion Steam Shovel Co., Marion, O.

DREDGES, HYDRAULIC

Bucyrus Co., South Milwaukee, Wis.
Ellicott Mach. Corp., Baltimore, Md.
Fairbanks Steam Shovel Co., Marion, O.
Marion Steam Shovel Co., Marion, O.
Morris Machine Works, Baldwinsville, N. Y.

DREDGING MACHINERY

*S. Flory Mfg. Co., Bangor, Pa.
*Lidgerwood Mfg. Co., New York

DREDGING PUMPS AND ACCESSORIES

Erie Pump & Engine Wks., Medina, N. Y.

DRILLS, AIR AND ROCK

*Dallett Co., The, Philadelphia, Pa.
*Denver Rock Drill Mfg. Co., Denver, Colo.
*McKiernan-Terry Drill Co., New York.
*Sullivan Machinery Co., Chicago, Ill.
*Wood Drill Wks., Paterson, N. J.
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, Ohio.
Cleveland Rock Drill Co., Cleveland, Ohio.
Helwig Mfg. Co., St. Paul, Minn.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

DRILLS, CORE

*McKiernan-Terry Drill Co., New York.
*Standard Diamond Drill Co., Chicago, Ill.
*Sullivan Machinery Co., Chicago, Ill.
Dobbins Core Drill Co., Inc., New York.
Ingersoll-Rand Co., New York.

DRILLS, HAMMER (PNEUMATIC)

*Denver Rock Drill Mfg. Co., Denver, Colo.
*McKiernan-Terry Drill Co., New York.
*Sullivan Machinery Co., Chicago, Ill.
*Wood Drill Works, Paterson, N. J.
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Cleveland Rock Drill Co., Cleveland, O.
Helwig Mfg. Co., St. Paul, Minn.
Ingersoll-Rand Co., New York.

DRILLS FOR WELLS AND BLAST HOLES

(See Well Drilling Machinery)

DRUMS, HOLDING

*Blaw-Knox Co., Pittsburgh, Pa.
*Clyde Iron Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Hayward Co., New York.
Monighan Machine Co., Chicago, Ill.

DRYERS, ASPHALT AND CEMENT

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Blower Co., Detroit, Mich.
American Process Co., New York.
Atlas Dryer Co., Cleveland, O.
Bartlett & Snow Co., C. O., Cleveland, O.
Cummer & Son Co., F. D., Cleveland, O.
Ruggles-Coles Eng. Co., New York.

DRYERS, SAND AND GRAVEL

*Asroil Burner Co., Union Hill, N. J.
*Littleford Bros., Cincinnati, Ohio.
Bartlett & Snow Co., C. O., Cleveland, Ohio.
Chase & Lyman, Boston, Mass.

DUMP BODIES FOR MOTOR TRUCKS

*Archer Iron Works, Chicago, Ill.
*Heil Company, Milwaukee, Wis.
*Herr Dump Car Mfg. Co., Coatesville, Pa.
*The Hug Co., Highland, Ill.
*Hughes-Keenan Co., Mansfield, Ohio
*Insley Mfg. Co., Indianapolis, Ind.
*Littleford Bros., Cincinnati, O.
*Mack Trucks, Inc., New York.
*Marion Steel Body Co., Marion, Ohio
*Superior Body Corpn., Marion, Ind.
*Stewart Iron Wks. Co., Cincinnati, Ohio
*Wood Hydr. Hoist & Body Co., Detroit, Mich.
Columbia Body Corp., Columbia, Pa.
Columbian Steel Tank Co., Kansas City, Mo.
Ditwiler Mfg. Co., Galion, Ohio
Easton Car & Const'n Co., Easton, Pa.
Galion All Steel Body Co., Galion, Ohio.
Griscom-Russell Co., New York.
Jennings Automatic Dump Body, Roanoke, Va.
Lee Trailer & Body Co., Chicago, Ill.
Mandt Body Co., Keokuk, Iowa.
Pechstein Iron Works, Keokuk, Iowa.
Van Dorn Iron Wks., Cleveland, Ohio.

DUMP CARTS AND WAGONS, HORSE DRAWN

*Acme Road Machinery Co., Frankfort, N. Y.
*Austin-Western Road Machy. Co., Chicago, Ill
*La Plant-Choate Mfg. Co., Cedar Rapids, Ia.
*Russell Grader Mfg. Co., Minneapolis, Minn.

*Western Wheeled Scraper Co., Aurora, Ill.
Acme Wagon Co., Emigsville, Pa.
Austin Mfg. Co., Chicago, Ill.
Columbia Body Corp., Columbia, Pa.
Convertible Wagon-Trailers, Inc., Buffalo, N. Y.
Eagle Wagon Works, Auburn, N. Y.
Gilbert Mfg. Co., Aberdeen, S. D.
Holsbog & Bro., Geo. H., Jeffersonville, Ind.
Little Red Wagon Co., Omaha, Neb.
Stockland Road Mach'y Co., Minneapolis, Minn.
Watson Products Corp., Canastota, N. Y.

DUST LAYING (CALCIUM CHLORIDE)

*Dow Chemical Co, Midland, Mich.
*Solvay Process Co., New York
Carbondale Calcium Co., Carbondale, Pa.

DYNAMITE (See Explosives)

EJECTORS, SEWAGE (See Sewage Ejectors)

ELECTRIC GENERATORS AND MOTORS

Louis Allis Co., Milwaukee, Wis.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Crocker-Wheeler Co., Ampere, N. J.
Fairbanks, Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Idea Elec. & Mfg. Co., Mansfield, O.
Lincoln Electric Co., Cleveland, O.
Robbins & Myers Co., Springfield, O.
Triumph Electric Co., Cincinnati, O.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Western Electric Co., New York.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

ELECTRIC LAMPS

General Electric Co., Schenectady, N. Y.
Westinghouse Lamp Co., New York.

ELECTRIC LIGHTING PLANTS

*Climax Engineering Co., Clinton, Ia.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Cushman Motor Wks., Lincoln, Neb.
Fairbanks, Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Universal Motor Co., Oshkosh, Wis.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Western Electric Co., New York.

ELECTRIC SUPPLIES, METERS, ETC.

General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC TRANSFORMERS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC WIRES AND CABLES. (See "Wire and Cable")

ELEVATORS, BUCKET

*Atlas Eng. Co., Milwaukee, Wis.
*Austin-Western Road Machy. Co., Chicago, Ill.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Littleford Bros., Cincinnati, Ohio.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Spears-Wells Mach'y Co., Oakland, Cal.
*Universal Road Machinery Co., Kingston, N. Y.
Austin Mfg. Co., Chicago, Ill.
Bartlett & Snow Co., C. O., Cleveland, O.
Chain Belt Co., Milwaukee, Wis.
Fairfield Engineering Co., Marion, Ohio
Gifford-Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Olson & Co., Sam'l, Chicago, Ill.
Robins Conv. Belt Co., New York.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.
Worthington Pump & Mchy. Corp., New York.

ELEVATORS, PASSENGER, FREIGHT, ETC.

Amer. Elevator & Mach. Co., Louisville, Ky.
Atlantic Elevator Co., Inc., Philadelphia, Pa.
Bay State Elevator Co., Springfield, Mass.
Haughton Elev. & Mach. Co., Toledo, Ohio.
Kaestner & Hecht Co., Chicago, Ill.
Llewellyn Iron Works, Los Angeles, Cal.
Montgomery Elevator Co., Moline, Ill.
Otis Elevator Co., New York.
Ridgway & Son Co., C., Coatesville, Pa.
See Elec. Elevator Co., A. B., New York.
Speidel, J. G., Reading, Pa.
Warner Elevator Mfg. Co., Cincinnati, O.
Warsaw Elevator Co., Warsaw, N. Y.

ENGINES, GAS AND GASOLINE

*Alamo Engine Co., Hillsdale, Mich.
*Climax Engineering Co., Clinton, Ia.
*Domestic Engine & Pump Co., Shippensburg, Pa.
*Hercules Corpn., Evansville, Ind.
*Hinkley Motors, Inc., Detroit, Mich.
*Turner & Moore Mfg. Co., Detroit, Mich.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Buda Co., Harvey, Ill.
C. H. & E. Manufacturing Co., Milwaukee, Wis.
Caterpillar Tractor Co., Peoria, Ill.
Charter Gas Eng. Co., Sterling, Ill.
Chicago Pneumatic Tool Co., New York.
Cook Motor Co., Delaware, Ohio
Cushman Motor Wks., Lincoln, Neb.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Foos Gas Engine Co., Springfield, Ohio.
Fuller & Johnson Mfg. Co., Madison, Wis.
Gade Bros. Mfg. Co., Iowa Falls, Iowa.
Hercules Motors Corp., Canton, O.
John Lauson Mfg. Co., New Holstein, Wis.
Le Roi Co., Milwaukee, Wis.
"New-Way" Motor Co., Lansing, Mich.
Novo Engine Co., Lansing, Mich.
Sterling Engine Co., Buffalo, N. Y.
Universal Motor Co., Oshkosh, Wis.
Weber Engine Co., Kansas City, Mo.
Wellman-Seaver-Morgan Co., Cleveland, O.
Worthington Pump & Mchy. Corp., New York.

ENGINES, HOISTING
(See Hoists)

ENGINES, KEROSENE

*Alamo Engine Co., Hillsdale, Mich.
*Climax Engineering Co., Clinton, Iowa

ENGINES, OIL

DIESEL

*Hadfield-Penfield Steel Co., Bucyrus, Ohio
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Busch-Sulzer Bros.-Diesel Eng. Co., St. Louis, Mo.
Fulton Iron Works Co., St. Louis, Mo.
McIntosh & Seymour Corp., Auburn, N. Y.
Nordberg Mfg. Co., Milwaukee, Wis.
St. Mary's Oil Eng. Co., St. Charles, Mo.
Western Machy. Co., Los Angeles, Cal.

SEMI-DIESEL

Anderson Fdry. & Mach. Co., Anderson, Ind.
Bessemer Gas Eng. Co., Grove City, Pa.
Buckeye Machinery Co., Lima, O.
Charter Gas Eng. Co., Sterling, Ill.
Chicago Pneumatic Tool Co., New York.
De La Vergne Machine Co., New York.
Fairbanks, Morse & Co., Chicago, Ill.
Foos Gas Engine Co., Springfield, Ohio.
Ingersoll-Rand Co., New York.
Lombard Governor Co., Ashland, Mass.
Muncie Oil Eng. Co., Muncie, Ind.
New London Ship and Engine Co., Groton, Conn.
Nordberg Mfg. Co., Milwaukee, Wis.
Stover Mfg. & Engine Co., Freeport, Ill.
Taylor Machine Co., Cleveland, O.
Weber Engine Co., Kansas City, Mo.
Worthington Pump & Mchy. Corp., New York.

ENGINES, PUMPING

*Climax Engineering Co., Clinton, Ia.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Cushman Motor Wks., Lincoln, Neb.
Hooven, Owens, Rentschler Co., Hamilton, O.
Murray Iron Wks., Burlington, Ia.
Nordberg Mfg. Co., Milwaukee, Wis.
Worthington Pump & Mchy. Corp., New York.

ENGINES, STEAM

*Dake Engine Co., Grand Haven, Mich.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Erie-Ball Engine Co., Pittsburgh, Pa.
Filer-Stowell Co., Milwaukee, Wis.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Loffel Co., J., Springfield, O.
Morris Machine Works, Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.
Norberg Mfg. Co., Milwaukee, Wis.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Vilter Mfg. Co., Milwaukee, Wis.

ENGINES, SWINGING
*Dake Engine Co., Grand Haven, Mich.
*Lidgerwood Mfg. Co., New York

EXCAVATING MACHINERY. (See Names Under Excavators, also Steam Shovels)

EXCAVATORS, CABLEWAY
*American Mfg. & Eng. Co., Kalamazoo, Mich.
*Lidgerwood Mfg. Co., New York.
Bucyrus Co., South Milwaukee, Wis.

EXCAVATORS, DITCH AND TRENCH
*Barber-Green Co., Aurora, Ill.
*Bay City Dredge Wks., Bay City, Mich.
*Byers Machine Co., Ravenna, Ohio.
*Clyde Iron Wks. Sales Co., Duluth, Minn.
*Harnischfeger Corp., Milwaukee, Wis.
*Insley Mfg. Co., Indianapolis, Ind.
*Keystone Driller Co., Beaver Falls, Pa.
*Lidgerwood Mfg. Co., New York
*Osgood Co., The, Marion, O.
*Russell Grader Mfg. Co., Minneapolis, Minn.
American Hoist & Derrick Co., St. Paul, Minn.
Austin Machinery Corp'n, Muskegon, Mich.
Buckeye Traction Ditcher Co., Findlay, Ohio.
Bucyrus Co., South Milwaukee, Wis.
Economy Excavator Co., Iowa Falls, Ia.
Erie Steam Shovel Co., Erie, Pa.
Fairbanks Steam Shovel Co., Marion, O.
Hayward Co., The, New York City.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.
Owensboro Ditcher & Grader Co., Owensboro, Ky.
Parsons Co., Newton, Ia.
Topping Machy. Co., Chas. T. Dayton, O.

EXCAVATORS, DRAG-LINE
*Bay City Dredge Works, Bay City, Mich.
*Byers Machine Co., Ravenna, Ohio.
*Clyde Iron Wks. Sales Co., Duluth, Minn.
*Harnischfeger Corp., Milwaukee, Wis.
*Lidgerwood Mfg. Co., New York
*Osgood Co., The, Marion, O.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Sauerman Bros., Chicago, Ill.
*Smith Co., T. L., Milwaukee, Wis.
Austin Machinery Corp'n, Muskegon, Mich.
Gallion Iron Works & Mfg. Co., Gallion, Ohio
Browning Co., Cleveland, O.
Bucyrus Co., South Milwaukee, Wis.
Economy Excavator Co., Iowa Falls, Ia.
Erie Steam Shovel Co., Erie, Pa.
Gade Excavator Works, C. L., Iowa Falls, Iowa.
Green, L. P., Chicago, Ill.
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Link-Belt Co., Chicago, Ill.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.

EXPANDED METAL
*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Consolidated Expanded Metal Co., Braddock, Pa.
Kalman Steel Co., Chicago, Ill.
Northwestern Expanded Metal Co., Chicago, Ill.
Youngstown Pressed Steel Co., Warren, O.

EXPANSION JOINT MATERIAL
*Barber Asphalt Co., Philadelphia, Pa.
*Barrett Co., New York
*Carey Co., Philip, Cincinnati, Ohio.
*Texas Company, New York.
*Truscon Steel Co., Youngstown, O.
Hoosier Asphalt Co., Alexandria, Ind.
Pioneer Asphalt Co., Lawrenceville, Ill.
Servicised Product Corp., Chicago, Ill.
Waring-Underwood Co., Philadelphia, Pa.

EXPLOSIVES
Atlas Powder Co., Wilmington, Del.
Du Pont de Nemours & Co., E.I., Wilmington, Del.
Giant Powder Co., Cons., San Francisco, Cal.
Grasselli Powder Co., Cleveland, O.
Hercules Powder Co., Wilmington, Del.

FENCING
*Stewart Iron Works Co., Cincinnati, Ohio
*Wickwire Spencer Steel Corp., New York.
Adrian Wire Fence Co., Adrian, Mich.
American Steel & Wire Co., Chicago, Ill.
Anchor Post Iron Works, New York.
Cyclone Fence Co., Waukegan, Ill.
Frost-Superior Fence Co., Warren, Ohio
Indiana Steel & Wire Co., Muncie, Ind.
Nitselman Bros., Muncie, Ind.
Michigan Wire Fence Co., Adrian, Mich.
Page Steel & Wire Prod. Corp., Bridgeport, Conn.
Pittsburgh Steel Co., Pittsburgh, Pa.
Texas Cyclone Fence Co., Fort Worth, Tex.
Youngstown Sheet & Tube Co., Youngstown, O.

PILING EQUIPMENT, STEEL
Art Metal Constr. Co., Jamestown, N. Y.
Berger Mfg. Co., Canton, O.
General Fireproofing Co., Youngstown, O.
Van Dorn Iron Works, Cleveland, O.

FILTERS, OIL
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

FILTERS, WATER
American Water Softener Co., Philadelphia, Pa.
Graver Corporation, E. Chicago, Ind.
International Filter Co., Chicago, Ill.
Norwood Engineering Co., Florence, Mass.
Roberts Filter Co., Darby, Pa.
Scaife & Sons Co., W. B., Pittsburgh, Pa.

FIRE ALARM SYSTEMS
Gamewell Co., Newton Upper Falls, Mass.

FIRE ALARM SIRENS
*Union Water Meter Co., Worcester, Mass.
Erick Elec. Siren Co., St. Paul, Minn.
Federal Sign System, Chicago, Ill.
Hendrie & Bolthoff Mfg. & Sup. Co., Denver, Col
Sterling Siren Fire Alarm Co., Rochester, N. Y.

FIRE APPARATUS, MOTOR
*Mack Trucks, Inc., New York.
Ahrens-Fox Fire Engine Co., Cincinnati, O.
American-La France Fire Eng. Co., Elmira, N. Y.
Brockway Motor Fire App. Co., Cortlandt, N. Y.
Foamite-Childs Corp., Utica, N. Y.
Hale Fire Pump Co., Conshohocken, Pa.
Northern Fire Apparatus Co., Minneapolis, Minn.
Obenchain-Boyer Co., Logansport, Ind.
Pirsch & Sons Co., Peter, Kenosha, Wis.
Prospect Fire Engine Co., Prospect, O.
Seagrave Co., Columbus, O.
Stutz Fire Engine Co., Indianapolis, Ind.
Waterous Fire Engine Works, St. Paul, Minn.

FIRE EXTINGUISHERS, CHEMICAL
American-La France Fire Eng. Co., Elmira, N. Y.
Buffalo Fire Appliance Corp., Buffalo, N. Y.
Cross Mfg. Co., C. J., Inc., New York.
Foamite-Childs Co., Utica, N. Y.
Pyrene Mfg. Co., Newark, N. J.

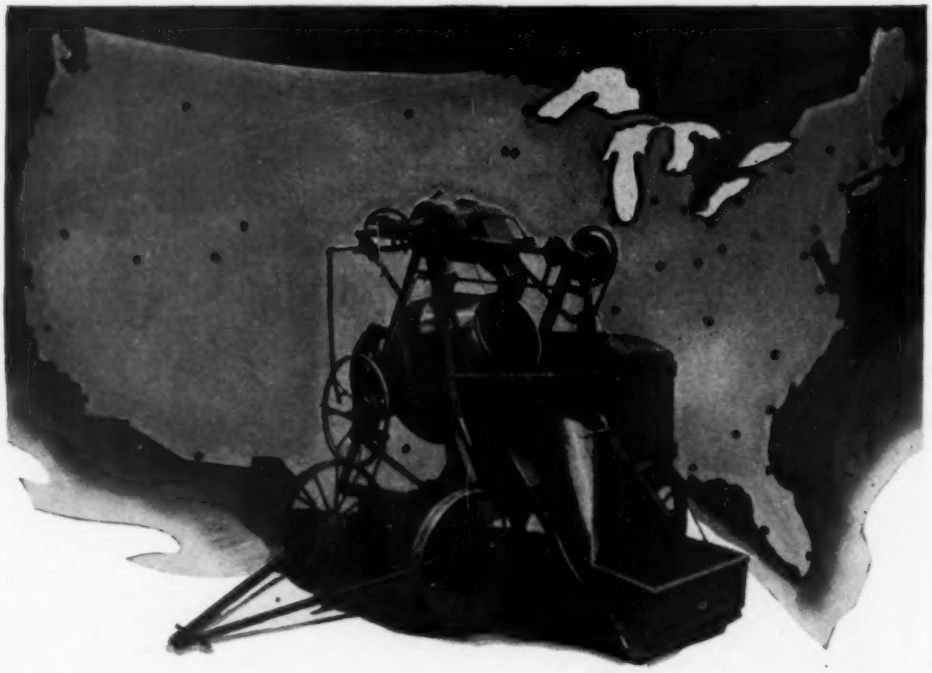
FIRE HOSE (See Hose, Fire)

FIREPROOF BUILDING MATERIAL
*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Detroit Steel Prod. Co., Detroit, Mich.
General Fireproofing Co., Youngstown, O.
Kalman Steel Co., Chicago, Ill.
Keasbey & Mattison Co., Ambler, Pa.
Kinnear Mfg. Co., Columbus, O.
National Fireproofing Co., Pittsburgh, Pa.
United States Gypsum Co., Chicago, Ill.
Youngstown Pressed Steel Co., Warren, O.

FIRST AID EQUIPMENT
American-La France Fire Eng. Co., Elmira, N. Y.

FLEXIBLE JOINTS
*Central Foundry Co., New York
*U. S. C. I. Pipe & Fdry Co., Burlington, N. J.
Coldwell-Wilcox Co., Newburgh, N. Y.
Crane Co., Chicago, Ill.
United Lead Company, New York.

FLOORING, COMPOSITION
*Barber Asphalt Co., Philadelphia, Pa.
*Barrett Co., New York
Am. Mason Safety Tread Co., Lowell, Mass.
Johns-Manville, Inc., New York.
Marine Decking & Supply Co., Phila., Pa.
Muller, Franklyn R., & Co., Waukegan, Ill.



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FLOORS, WOOD BLOCK
*Barrett Co., New York.
Carter Bioxonend Flooring Co., Kansas City, Mo
Jennison-Wright Co., Toledo, O.
Midland Creosoting Co., Toledo, O.
Republic Creosoting Co., Indianapolis, Ind.
Sou. Wood Preserving Co., Atlanta, Ga.
Wyckoff Pipe & Creosoting Co., New York.

FLUSH TANKS
*Pacific Flush Tank Co., Chicago and New York

FLUSHERS, STREET. (See Street Flushers and Sprinklers.)

FORD AND FORDSON EQUIPMENT

AIR COMPRESSORS FOR FORDSONS
*Curtis Pneumatic Machinery Co., St. Louis, Mo.
Schramm, Inc., Westchester, Pa.

AIR COMPRESSORS FOR FORD TRUCKS
*Domestic Engine & Pump Co., Shippensburg, Pa.
Schramm, Inc., Westchester, Pa.

CONCRETE MIXERS ON FORD TRUCKS
*American Cement Machine Co., Keokuk, Iowa
*Archer Iron Works, Chicago, Ill.
Milwaukee Concrete Mixer Co., Milwaukee, Wis.

DUMP BODIES FOR FORD TRUCKS
*Archer Iron Works, Chicago, Ill.
*Heil Co., Milwaukee, Wis.
*Herr Dump Body Mfg. Co., Coatesville, Pa.
*Hughes-Keenan Co., Mansfield, Ohio.
*Marion Steel Body Co., Marion, Ohio
*Stewart Iron Works Co., Cincinnati, Ohio
*Superior Boiler Works, Marion, Ind.
*Wood Hydr. Hoist & Body Co., Detroit, Mich.
American Production & Trading Co., Chicago, Ill.
Anthony Co., Streator, Ill.
Columbian Steel Tank Co., Kansas City, Mo.
Ditwiler Mfg. Co., Galion, Ohio
Eagle Wagon Works, Auburn, N. Y.
Easton Car & Const'n Co., Easton, Pa.
Galion All Steel Body Co., Galion, O.
Griscom-Russell, New York.
Jennings Auto. Dump Body Co., Roanoke, Va.
Lee Trailer & Body Co., Chicago, Ill.
Mandt Co., Keokuk, Iowa.
Martin-Parry Corp., York, Pa.
N. Y. Cent. Iron Wks. Co., Inc., Hagerstown, Md.
Pechstein Iron Works, Keokuk, Iowa.
Thompson Mfg. Co., Williston, S. C.
Van Dorn Iron Works, Cleveland, Ohio.

FORD MOTOR PUMPER
*American Steam Pump Co., Battle Creek, Mich.

FORD PLOWS
Roderick Lean Mfg. Co., Mansfield, Ohio.

FORD REPLACEMENT UNITS (AXLES AND TRANSMISSIONS)
*Hinckley Motors, Inc., Detroit, Mich.
*Ruckstell Sales & Mfg. Co., New York
Warford Corpn., New York

FORD SPECIAL BODIES
Standard Commercial Body Corp., B'klyn, N. Y.

FORD TRUCK EXTENSION FRAMES
Swedish Crucible Steel Co., Detroit, Mich.

FORDSON DITCHING MACHINE
Chas. T. Topping, Dayton, O.

FORDSON HOISTS
*Clyde Iron Works Sales Co., Duluth, Minn.
Ernted Machinery Mfg. Co., Portland, Oregon.
Oklahoma Eng. & Fdry. Co., Muskogee, Okla.
Otis Engine Corp., New York.
Sheffield Tool & Supply Co., Sheffield, Pa.

FORDSON INDUSTRIAL LOCOMOTIVES
Adamson Motor Co., Birmingham, Ala.
Brookville Truck & Tractor Co., Brookville, Pa.
Whitehead & Kales Co., Detroit, Mich.

FORDSON POWER SHOVELS
*Insley Manufacturing Co., Indianapolis, Ind.
Anthony Company, The, Streator, Ill.
Fairbanks Steam Shovel Co., Marion, Ohio
Glasgow Engineering Company, St. Louis, Mo.
Mandt Company, The, Keokuk, Iowa.
Milwaukee Electric Crane & Mfg. Co., Milwaukee, Wis.

FORDSON ROAD GRADERS
*Good Roads Machinery Co., Kennett Square, Pa.
*Hadfield-Penfield Steel Co., Bucyrus, Ohio
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Shaw-Enochs Tractor Co., Minneapolis, Minn.
Adams, J. D. & Co., Indianapolis, Ind.
Gilbert Mfg. Co., Aberdeen, S. D.
Wehr Co., Milwaukee, Wis.

FORDSON ROAD ROLLERS
*Acme Road Mach'y Co., Frankfort, N. Y.
*Austin-Western Road Mach. Co., Chicago, Ill.
*Good Roads Machy. Co., Kennett Square, Pa.
Galion Iron Works & Mfg. Co., Galion, Ohio
Horst & Strieter Co., Davenport, Iowa

FORDSON SAW RIGS
*Amer. Saw Mill Mach'y Co., Hackettstown, N. J.
*Miami Trailer-Scraper Co., Troy, Ohio

FORDSON SCRAPER OUTFITS
*Killefer Mfg. Co., Los Angeles, Calif.
*Miami Trailer-Scraper Co., Troy, Ohio.
Miskin Scraper Works, Ucon, Idaho.
Gustav Schaefer Wagon Co., Cleveland, O.

FORDSON TRACTION TREADS
*Tractor Grip Wheel Co., Toledo, Ohio
Full-Crawler Co., Milwaukee, Wis.
A. C. Johnson Products, Racine, Wis.

FORDSON TRACTOR TRUCKS
Toppins Tractor Truck Co., Appleton, Wis.

FORDSON TRAILER EQUIPMENT
*Miami Trailer-Scraper Co., Troy, Ohio.
Easton Car & Const'n Co., Easton, Pa.
Trail-Ford Corp., Ann Arbor, Mich.
Trailmobile Co., Cincinnati, O.
Troy Trailer & Wagon Co., Troy, O.
Whitehead & Kales Co., Detroit, Mich.

FORDSON TRUCK AND WAGON LOADERS
*George Haiss Mfg. Co., New York
*Spears-Wells Mach'y Co., Oakland, Cal.
Lessman Loader Mfg. Co., Des Moines, Iowa.
N. P. Nelson Iron Works, Brooklyn, N. Y.
Specialty Engineering Co., Philadelphia, Pa.

FORGES
Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.
Hauck Mfg. Co., Brooklyn, N. Y.

FORGES, OIL
*Mead-Morrison Mfg. Co., East Boston, Mass.

FORM CLAMPS
*Insley Mfg. Co., Indianapolis, Ind.
Marion Malleable Iron Works, Marion, Ind.
Universal Form Clamp Co., Chicago, Ill.

FORMS, CONCRETE
*Blaw-Knox Co., Pittsburgh, Pa.
*Connery & Co., Philadelphia, Pa.
*Heltzel Steel Form & Iron Co., The, Warren, O.
*Lakewood Engineering Co., Cleveland, O.
*Raber & Lang Mfg. Co., Kendallville, Ind.
*Truscon Steel Co., Youngstown, O.
Concrete Form Co., Inc., Syracuse, N. Y.
Hotchkiss Steel Products Co., Binghamton, N. Y.
Metal Forms Corp., Milwaukee, Wis.

FORMGRADERS
Edward G. Carr, Chicago, Ill.

FOUNTAINS, DRINKING
Casey-Hedges Co., Chattanooga, Tenn.
Clow & Sons, Jas. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Mott Iron Wks., J. L., New York.
Murdock Mfg. & Supply Co., Cincinnati, Ohio.
Puro San. Dr. Ftn. Co., Haydenville, Mass.
Rundle-Spence Mfg. Co., Milwaukee, Wis.
Stewart Iron Works Co., Cincinnati, O.
Taylor Co., Halsey W., Warren, O.
Twentieth Century Brass Wks., Belleville, Ill.

FURNITURE AND FILES, STEEL
Art Metal Constn. Co., Jamestown, N. Y.
General Fireproofing Co., Youngstown, O.
Van Dorn Iron Works Co., Cleveland, O.

GARBAGE CANS. (See Cans)

GARBAGE DISPOSAL
American Beccari Corp., New York.
Balmer Corp., New York.
Bartlett, C. O. & Snow Co., Cleveland, O.
Decarie Incinerator Co., Long Island City, N. Y.
Goder Incinerator Corp., Chicago, Ill.
Hiler Eng. & Const. Co., Brooklyn, N. Y.
Morse-Boulger Destructor Co., New York.
Nye Odorless Crematory Co., Macon, Ga.

GARBAGE TRUCKS AND BODIES
*Heil Co., Milwaukee, Wis.
Convertible Wagon-Trailers, Inc., Buffalo, N. Y.
Holsbog & Bro., Geo. H., Jeffersonville, Ind.
Lee Trailer & Body Co., Chicago, Ill.
Tiffin Wagon Co., Tiffin, O.
Watson Products Corp., Canastota, N. Y.

GAS METERS. (See Meters, Gas.)

GAS PRODUCERS
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Wood & Co., R. D., Philadelphia, Pa.

GASOLINE STORAGE TANKS
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Biggs Boiler Works, Akron, Ohio.
Birmingham Tank Co., Birmingham, Ala.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Chicago Bridge & Iron Works, Chicago, Ill.
Graver Corp., East Chicago, Ind.
Scaife & Sons, Wm. B., Oakmont, Pa.
Tokheim Oil Tank & Pump Co., Ft. Wayne, Ind.
United Iron Works, Inc., Kansas City, Mo.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

GATES, SLUICE
*Ludlow Valve Mfg. Co., Troy, N. Y.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Coffin Valve Co., Boston, Mass.
Coldwell-Wilcox Co., Newburgh, N. Y.
Hardesty Mfg. Co., R., Denver, Colo.

GATES FOR PARKS AND CEMETERIES
*Stewart Iron Works Co., Cincinnati, O.
*Wickwire Spencer Steel Corp., Worcester, Mass.

GAUGES, WATER
Bristol Co., Waterbury, Conn.
Lunkenheimer Co., Cincinnati, O.
Walworth Mfg. Co., Boston, Mass.

GAUGES, SURFACE, RESERVOIR AND SPECIAL WATER-WORKS
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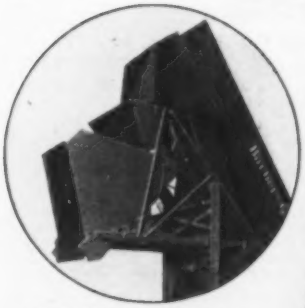

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Cook Paint & Varnish Co., Kansas City, Mo.
Detroit Graphite Co., Detroit, Mich.
Detroit White Lead Wks., Detroit, Mich.
Du Pont de Nemours & Co., Inc., E. I., Wilmington, Del.
Minwax Co., New York.
Protexol Corpn., New York.
Ruberoid Co., New York.
Sherwin-Williams Co., Cleveland, O.
Sonneborn Sons, Inc., L., New York.
Toch Bros., New York.
Tropical Paint & Oil Co., Cleveland, Ohio.
Truscon Laboratories, Detroit, Mich.

PAPERS, BLUE PRINT AND BROWN PRINT

Indianapolis Blue Print & Supply Co., Indianapolis, Ind.

PAPER, BUILDING, ROOFING, ETC.

*Barber Asphalt Co., Philadelphia, Pa.
*Barrett Co., New York.
*Carey Co., Philip, Cincinnati, Ohio.
Bird & Son, inc., E. Walpole, Mass.
Brown Co., Portland, Me.
Hydrex Asphalt Products Corp., New York.
Johns-Manville, Inc., New York.
National Roofing Co., Tonawanda, N. Y.
Ruberoid Co., New York.

PARK BENCHES

*Stewart Iron Works Co., Cincinnati, O.
Art Concrete Works, Pasadena, Calif.
Bausman Mfg. Co., Millersville, Pa.
Dow Co., Louisville, Ky.
Meyers Mfg. Co., Fred J., Hamilton, Ohio.
Mott Iron Wks., J. L., New York.

PAVING AND ROAD ROLLERS. (See Road and Paving Rollers)

PAVING BLOCKS, CREOSOTED WOOD. (See "Creosoted Blocks")

PAVING BRICK

Albion Shale Brick Co., Albion, Ill.
Alton Brick Co., Alton, Ill.
Binghamton Brick Co., Binghamton, N. Y.
Buckeye Shale Brick Co., Cleveland, Ohio
Buffalo Brick Co., Buffalo, Kans.
Burton Townsend Co., Zanesville, N. Y.
Central Clay Products Co., Wilkes-Barre, Pa.
Cleveland Brick & Clay Co., Cleveland, O.
Clydesdale Brick & Stone Co., Pittsburgh, Pa.
Coffeyville Vit. Brick & Tile Co., Coffeyville, Kans
Collinwood Shale Brick Co., Cleveland, O.
Corry Brick & Tile Corp., Corry, Pa.
Denny Renton Clay & Coal Co., Seattle, Wash.
Fayette Fire Brick Co., Uniontown, Pa.
Flint Brick Co., Des Moines, Ia.
Francis Vit. Brick Co., Boynton, Okla.
Georgia Vitrified Brick Co., Augusta, Ga.
Hammond Fire Brick Co., Fairmont, W. Va.
Hocking Valley Brick Co., Columbus, O.
Independence Pav. Br. Co., Independence, Kans.
Layton Fire Clay Co., McKeesport, Pa.
McAvoy Vit. Brick Co., Philadelphia, Pa.
Martinsville Brick Co., Martinsville, Ind.
Mayer Brick Co., C. P., Bridgeville, Pa.
Metropolis Paving Brick Co., Pittsburgh, Kans.
Metropolitan Paving Brick Co., Canton, O.
Mineral Wells Pav. Brick Co., Mineral Wells, Tx.
Moberly Paving Brick Co., Moberly, Mo.
Murphysboro Paving Brick Co., Murphysboro, Ill.
Nelsonville Brick Co., Nelsonville, O.
Patton Clay Mfg. Co., Patton, Pa.
Paxton Brick Co., Watsontown, Pa.
Peebles Paving Brick Co., Portsmouth, O.
Penna. Clay Co., Pittsburgh, Pa.
Pittsburgh Paving Brick Co., Pittsburgh, Kans.
Purington Paving Brick Co., Galesburg, Ill.
Russell Clay Mfg. Co., Alton, Ala.
Southern Clay Mfg. Co., Chattanooga, Tenn.
Springfield Paving Brick Co., Springfield, Ill.
Sterling Brick Co., Olean, N. Y.
Streator Clay Mfg. Co., Streator, Ill.
Terre Haute Vit. Brick Co., Terre Haute, Ind.
Thornton Fire Brick Co., Clarksburg, W. Va.
Thurber Brick Co., Thurber, Texas.
Toronto Fire Clay Co., Toronto, Ohio.
Trinidad Brick & Tile Co., Trinidad, Colo.
Veedersburg Paver Co., Veedersburg, Ind.
Western Shale Products Co., Fort Scott, Kans.
Westport Paving Brick Co., Westport, Md.

PAVING MACHINERY. (See Road and Paving Machinery)

PAVING GUARDS, STEEL

*Godwin Co., W. S., Baltimore, Md.

PAVING MATERIALS. (See "Asphalt," "Paving Brick," "Granite Block," etc.)

PAVING MIXERS. (See Concrete Mixers)

PAVING TOOLS

*Aeroil Burner Co., Union Hill, N. J.
*Barber Asphalt Co., Philadelphia, Pa.
*Connery & Co., Inc., Philadelphia, Pa.
*Littleford Bros. Co., Cincinnati, O.
*Warren Bros. Co., Boston, Mass.
Anderson Tool & Sup. Co., W. H., Detroit, Mich
Cummer & Sons Co., F. D., Cleveland, O.
Union Iron Works, Hoboken, N. J.

PERFORATED METALS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Hendrick Mfg. Co., Carbondale, Pa.

PICKS
Beall Tool Co., East Alton, Ill.
Hubbard Co., Pittsburgh, Pa.
Iron City Tool Works, Pittsburgh, Pa.
Klein-Logan Co., Pittsburgh, Pa.
Verona Tool Works, Verona, Pa.
Warren Tool & Forge Co., Warren, O.
Warwood Tool Co., Wheeling, W. Va.
Wyoming Shovel Wks., Wyoming, Pa.

PILE DRIVERS
*Clyde Iron Works Sales Co., Duluth, Minn.
*Lidgerwood Manufacturing Co., New York
*McKiernan-Terry Drill Co., New York.
*Mead-Morrison Mfg. Co., E. Boston, Mass.
Browning Co., Cleveland, O.
Industrial Works, Bay City, Mich.
McMyler Interstate Co., Cleveland, O.
Union Iron Works, Hoboken, N. J.

PILE HAMMERS, STEAM
*Clyde Iron Works Sales Co., Duluth, Minn.
*McKiernan-Terry Drill Co., New York.
Industrial Works, Bay City, Mich.
National Hoisting Eng. Co., Harrison, N. J.
Union Iron Works, Hoboken, N. J.
Vulcan Iron Works, Chicago, Ill.

PILING, CONCRETE
MacArthur Concrete Pile & Foundation Co., N. Y.
Raymond Concrete Pile Co., New York.

PILING, INTERLOCKING STEEL
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Jones & Laughlin Steel Co., Pittsburgh, Pa.

PIPE, CAST IRON
*Central Foundry Co., New York.
*National Cast Iron Pipe Co., Birmingham, Ala.
*U. S. Cast Iron Pipe & Fdy. Co., Burlington, N. J.
American Cast Iron Pipe Co., Birmingham, Ala.
Clow & Sons, J. B., Chicago, Ill.
Donaldson Iron Co., Emans, Pa.
Fox & Co., John, New York.
Glamorgan Pipe & Fdry. Co., Lynchburg, Va.
Lynchburg Foundry Co., Lynchburg, Va.
Warren Fdry. & Machine Co., New York.
Wood & Co., R. D., Philadelphia, Pa.

PIPE, CULVERT. (See Culverts)

PIPE, LEAD
United Lead Company, New York.

PIPE, REINFORCED CONCRETE
*Newark Concrete Pipe Co., Newark, N. J.
Concrete Products Co., Pittsburgh, Pa.
Core Joint Concrete Pipe Co., Baltimore, Md.
Independent Concrete Pipe Co., Indianapolis, Ind.
Lock Joint Pipe Co., E. Orange, N. J.
Massey Concrete Products Corp'n, Chicago, Ill.

PIPE, RIVETED STEEL OR IRON
*Blaw-Knox Co., Pittsburgh, Pa.
*Connery & Co., Inc., Philadelphia, Pa.
*Littleford Bros., Cincinnati, Ohio.
Abendroth & Root Mfg. Co., Newburgh, N. Y.
American Spiral Pipe Works, Chicago, Ill.
Canton Culvert & Silo Co., Canton, O.
Chatts. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
East Jersey Pipe Co., New York.
Hammond Iron Works, Warren, Pa.
Hardesty Mfg. Co., R., Denver, Colo.
Honhorst Co., Jos., Cincinnati, Ohio.
Lancaster Iron Works, Lancaster, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Tippet & Wood, Phillipsburg, N. J.
Welter Mfg. Co., Chicago, Ill.

PIPE, SPIRAL RIVETED
Abendroth & Root Mfg. Co., Newburgh, N. Y.
American Spiral Pipe Works, Chicago, Ill.

PIPE, STEEL
Central Tube Co., Pittsburgh, Pa.
East Jersey Pipe Co., New York.
Jones & Laughlin Steel Co., Pittsburgh, Pa.
National Tube Co., Pittsburgh, Pa.
Republic Iron & Steel Co., Youngstown, O.
Spang-Chalfont & Co., Pittsburgh, Pa.
Wheeling Steel Corp., Wheeling, W. Va.
Youngstown Sheet & Tube Co., Youngstown, O.

PIPE, WOOD
American Wood Pipe Co., Tacoma, Wash.
Continental Pipe Mfg. Co., Seattle, Wash.
Michigan Pipe Co., Bay City, Mich.
Pacific Tank & Pipe Co., San Francisco, Cal.
Redwood Mfrs. Co., San Francisco, Cal.
Standard Wood Pipe Co., Williamsport, Pa.
Wyckoff & Sons Co., A., Elmira, N. Y.

PIPE, WROUGHT IRON
Byers Co., A. M., Pittsburgh, Pa.
Reading Iron Co., Reading, Pa.

PIPE BENDING MACHINES
Amer. Pipe Bending Mach. Co., Boston, Mass.
Walworth Mfg. Co., Boston, Mass.

PIPE COVERING

AIRCELL
*Carey Co., Philip, Cincinnati, Ohio.
Ehret Magnesia Mfg. Co., Valley Forge, Pa.
Johns-Manville, Inc., New York.
Keasbey & Mattison Co., Ambler, Pa.
Nat'l Asbestos Co., Jersey City, N. J.
Norristown Mag. & Asb. Co., Norristown, Pa
Sall Mt. Co., Chicago, Ill.
Watson Co., H. F., Erie, Pa.

85 PER CENT MAGNESIA
*Carey Co., Philip, Cincinnati, Ohio.
Ehret Magnesia Co., Valley Forge, Pa.
Johns-Manville, Inc., New York.
Keasbey & Mattison Co., Ambler, Pa.

WOOD
Continental Pipe Mfg. Co., Seattle, Wash.
Redwood Mfrs. Co., San Francisco, Cal.
Ric-Wil Co., Cleveland, O.
Wyckoff & Son Co., A., Elmira, N. Y.

PIPE CUTTERS. (See Cutters, Pipe, Hand.)

PIPE FITTINGS
*Central Foundry Co., New York.
*Nat'l Cast Iron Pipe Co., Birmingham, Ala.
*U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.
American C. I. Pipe Co., Birmingham, Ala.
Builders Iron Fdry., Providence, R. I.
Clow & Sons, J. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Lunkenheimer Co., Cincinnati, O.
Reading Steel Casting Co., Inc., Bridgeport, Conn
Warren Fdry. & Mach. Co., New York.
Wood & Co., R. D., Philadelphia, Pa.

PIPE HANDLING MACHINERY
Mueller Company, Decatur, Ill.
Taylor Portable Steel Derrick Co., Chicago, Ill.

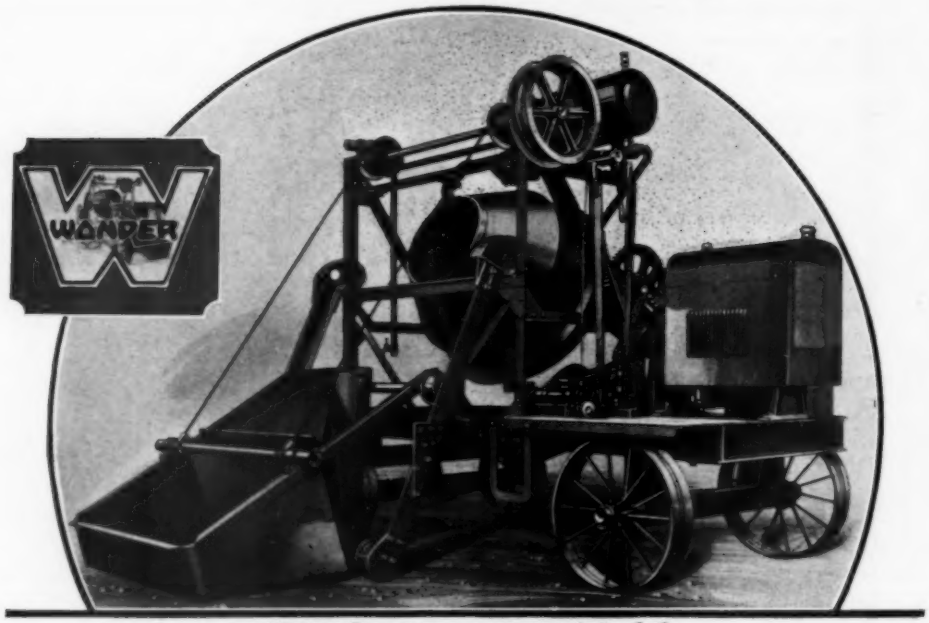
PIPE JOINT COMPOUND. (Sewer)
*Carey Co., Philip, Cincinnati, Ohio.
*Pacific Flush Tank Co., Chicago and New York
G. K. Sales Co., Macungie, Pa.
Leadite Company, Inc., Philadelphia, Pa.
Ruberoid Co., New York.
Waring-Underwood Co., Philadelphia, Pa.

PIPE JOINT MATERIAL. (Cast Iron)
Lead-Hydro-Tite Co., Boston, Mass.
Leadite Co., The, Philadelphia, Pa.
United Lead Co., New York.

PLAYGROUND APPARATUS
American Playground Device Co., Anderson, Ind
Chicago Gymnasium Equip. Co., Chicago, Ill.
Everwear Mfg. Co., Springfield, O.
George, Howard, Philadelphia, Pa.
Hill-Standard Co., Anderson, Ind.
Medart Mfg. Co., Fred., St. Louis, Mo.
Mitchell Mfg. Co., Milwaukee, Wis.
Patterson-Williams Co., San Jose, Calif.
Spalding & Bros., A. G., Chicopee, Mass.
Zieg Mfg. Co., F. B., Fredericktown, Ohio

PLOWS, CONTRACTORS
*Austin-Western Rd. Mach. Co., Chicago, Ill.
*Burch Plow Works Co., Crestline, O.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Adams & Co., J. D., Indianapolis, Ind.

** Indicates that the manufacturer carries an advertisement. See index facing inside back cover.*



Wonder 14——1925 Model

10 Seconds to Charge—5 Seconds to Discharge

THE rapid charging and discharging of the WONDER "14" combined with the fast and thorough WONDER mixing action enables you to greatly increase your daily yardage.

This is accomplished without sacrificing mixing time because the WONDER "14" charges in 10 seconds and it requires but 5 seconds for the entire mixed batch to pour from the drum.

The WONDER power tilt is the highest development in a power discharge. It is simple, rapid and positive in action, automatically stops in both the charging and discharging positions and is the first successful power tilt used on a Single Opening Tilting Mixer.

The loader is of the track type with its extension advantages. A four cylinder 10-15 H. P. power plant insures a surplus amount of power.

The WONDER catalog fully describes this model. Send for your copy today!

Construction Machinery Co.
WATERLOO, IOWA

WESTERN OFFICE
Los Angeles, California
455 East 3rd St.

CENTRAL OFFICE
Indianapolis, Indiana
315 W. Maryland St.

EASTERN OFFICE
Philadelphia, Pennsylvania
Widener Bldg.

WONDER MIXERS

American Steel Scraper Co., Sidney, O.
Caterpillar Tractor Co., Peoria, Ill.
Deere & Co., Moline, Ill.
International Harvester Co., Chicago, Ill.
Moline Plow Co., Rock Island, Ill.
Oliver Chilled Plow Works, South Bend, Ind.
Roderick Lean Mfg. Co., Mansfield, Ohio
Sidney Steel Scraper Co., Sidney, O.
Slusser-McLean Scraper Co., Sidney, O.
Smith & Sons Mfg. Co., Kansas City, Mo.
Western Wheeled Scraper Co., Aurora, Ill.
Wiard Plow Co., Batavia, N. Y.

PLUMBING SUPPLIES
Clow & Sons, J. B., Chicago, Ill.
Crane Co., Chicago, Ill.
Glauber Brass Mfg. Co., Cleveland, O.
Mott Iron Wks., J. L., New York.
Mueller Company, Decatur, Ill.
Rundle-Spence Mfg. Co., Milwaukee, Wis.
United Brass Mfg. Co., Cleveland, O.
Walworth Mfg. Co., Boston, Mass.

POLES, STEEL STRUCTURAL
*Blaw-Knox Co., Pittsburgh, Pa.
Electric Railway Equipment Co., Cincinnati, O.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.

PORTABLE BUILDINGS
*Blaw-Knox Co., Pittsburgh, Pa.
*Littleford Bros., Cincinnati, Ohio.
*Truscon Steel Co., Youngstown, O.
Milwaukee Corrugating Co., Milwaukee, Wis.

PORTABLE STEEL DERRICKS. (See Derricks, Steel Portable.)

PORTLAND CEMENT. (See Cement.)

POWDER. (See Explosives.)

POWER PLANTS, INDUSTRIAL
*Climax Engineering Co., Clinton, Iowa
*Hercules Corpn., Evansville, Ind.
*Hinkley Motors, Inc., Detroit, Mich.
*Turner & Moore Mfg. Co., Detroit, Mich
Cook Motor Co., Delaware, Ohio
Hercules Motor Corp., Canton, Ohio.

PUMPS, AIR LIFT
*American Steam Pump Co., Battle Creek, Mich.
*Sullivan Machinery Co., Chicago, Ill.
Harris Air Pump Co., Indianapolis, Ind.
Indiana Air Pump Co., Indianapolis, Ind.
Ingersoll-Rand Co., New York.

PUMPS, BOILER FEED
*American Steam Pump Co., Battle Creek, Mich.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Aurora Pump & Mfg. Co., Aurora, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Steam Pump Co., Buffalo, N. Y.
Cameron Steam Pump Works, A. S., New York
Dayton-Dowd Co., Quincy, Ill.
Dean Bros. Co., Indianapolis, Ind.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., Salem, O.
Erie Pump & Engine Wks., Medina, N. Y.
Fairbanks, Morse & Co., Chicago, Ill.
Gardner Governor Co., Quincy, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Indiana Air Pump Co., Indianapolis, Ind.
LeCourtenay Co., Newark, N. J.
Morris Machine Works, Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.
Northern Fire Apparatus Co., Minneapolis, Minn.
Ramsey Pump Co., Seneca Falls, N. Y.
Scranton Pump Co., Scranton, Pa.
Union Steam Pump Co., Battle Creek, Mich.
Vogt Bros. Mfg. Co., Louisville, Ky.
Warren Steam Pump Co., Warren, Mass.
Weinman Pump Mfg. Co., Columbus, O.
Yeomans Bros. Co., Chicago, Ill.

PUMPS, CENTRIFUGAL
*American Steam Pump Co., Battle Creek, Mich.
*Domestic Engine & Pump Co., Shippensburg, Pa.
*Keystone Driller Co., Beaver Falls, Pa.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, Aurora, Ill.
Aurora Pump & Mfg. Co., Aurora, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Cameron Steam Pump Works, A. S., New York.
Dayton-Dowd Co., Quincy, Ill.
De Laval Steam Turbine Co., Trenton, N. J.
Erie Pump & Engine Works, Medina, N. Y.
Fairbanks, Morse & Co., Chicago, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Indiana Air Pump Co., Indianapolis, Ind.
LeCourtenay Co., Newark, N. J.
Manistee Iron Wks., Manistee, Mich.
Morris Machine Works, Baldwinsville, N. Y.
Novo Engine Co., Lansing, Mich.
Ramsey Pump Co., Seneca Falls, N. Y.
Schramm, Inc., West Chester, Pa.
Tokheim Oil Tank & Pump Co., Ft. Wayne, Ind.
United Iron Works, Inc., Kansas City, Mo.
Wheeler Condenser & Eng. Co., Carteret, N. J.
Worthington Pump & Mchy. Corp., New York.
Yeomans Bros. Co., Chicago, Ill.

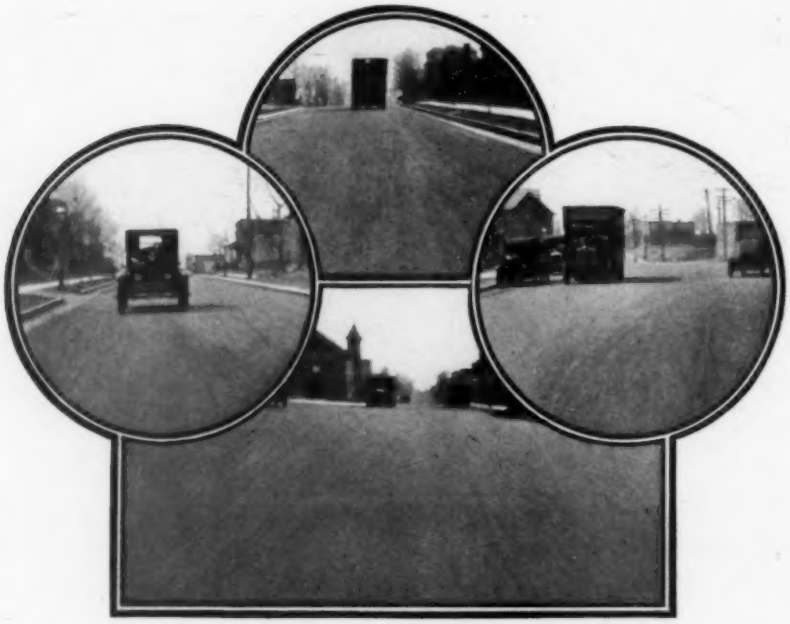
PUMPS, CONTRACTORS'
*American Steam Pump Co., Battle Creek, Mich.
*Construction Mach'y Co., Waterloo, Ia.
*Domestic Engine & Pump Co., Shippensburg, Pa.
*Kinney Mfg. Co., Boston, Mass.
*Smith Co., P. L., Milwaukee, Wis.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, Aurora, Ill.
Aurora Pump & Mfg. Co., Aurora, Ill.
Barnes Mfg. Co., Mansfield, O.
Buda Co., Harvey, Ill.
Cameron Steam Pump Works, A. S., New York.
Carter Co., Ralph B., New York.
C. H. & E. Manufacturing Co., Milwaukee, Wis.
Dayton-Dowd Co., Quincy, Ill.
Deming Co., Salem, Ohio.
Emerson Pump & Valve Co., Alexandria, Va.
Erie Pump & Engine Works, Medina, N. Y.
Fairbanks, Morse & Co., Chicago, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
LeCourtenay Co., Newark, N. J.
McGowan Co., J. H., Cincinnati, O.
Morris Machine Works, Baldwinsville, N. Y.
Myers & Bro. Co., F. E., Ashland, O.
Novo Engine Co., Lansing, Mich.
Pulsometer Steam Pump Co., New York.
Ramsey Pump Co., Seneca Falls, N. Y.
Schramm, Inc., West Chester, Pa.
Standard Scale & Supply Co., Pittsburgh, Pa.
Van Nouhuys Machine Wks., Albany, N. Y.
Waldo Bros. & Bond Co., Boston, Mass.

PUMPS, DEEP WELL
*American Steam Pump Co., Battle Creek, Mich.
*Domestic Engine & Pump Co., Shippensburg, Pa.
*Keystone Driller Co., Beaver Falls, Pa.
Aldrich Pump Co., Allentown, Pa.
American Well Works, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
Clark Co., H. W., Mattoon, Ill.
Cook, Inc., A. D., Lawrenceburg, Ind.
Deming Co., Salem, O.
Fairbanks, Morse & Co., Chicago, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Harris Air Pump Co., Indianapolis, Ind.
Indiana Air Pump Co., Indianapolis, Ind.
Layne & Bowler Co., Memphis, Tenn.
McDonald Mfg. Co., A. Y., Dubuque, Ia.
Midwest Engine Co., Indianapolis, Ind.
Myers & Bro. Co., F. E., Ashland, O.
Ramsey Pump Co., Seneca Falls, N. Y.
United Iron Works, Inc., Kansas City, Mo.
Weber Subterranean Pump Co., New York.

PUMPS, DREDGING
*American Steam Pump Co., Battle Creek, Mich.
Aldrich Pump Co., Allentown, Pa.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, Aurora, Ill.
Ellicott Machine Corp., Baltimore, Md.
Erie Pump & Engine Co., Medina, N. Y.
Morris Machine Works, Baldwinsville, N. Y.
Worthington Pump & Mchy. Corp., New York.

PUMPS, GASOLINE AND OIL
*Kinney Mfg. Co., Boston, Mass.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Gilbert & Barker Mfg. Co., Springfield, Mass.
Wayne Tank & Pump Co., Fort Wayne, Ind.

PUMPS, POWER
*American Steam Pump Co., Battle Creek, Mich.
*Domestic Engine & Pump Co., Shippensburg, Pa.
*Kinney Mfg. Co., Boston, Mass.
*Koehring Co., Milwaukee, Wis.
Alamo Iron Works, San Antonio, Tex.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Well Works, Aurora, Ill.
Aurora Pump & Mfg. Co., Aurora, Ill.
Barnes Mfg. Co., Mansfield, O.
Dayton-Dowd Co., Quincy, Ill.
De Laval Steam Turbine Co., Trenton, N. J.
Deming Co., Salem, O.
Evinrude Motor Company, Milwaukee, Wis.



Partridge Avenue, St. Louis, Mo.

THIS avenue was paved with Stanolind Paving Asphalt in 1918. To date practically nothing has been spent for maintenance, and today, after seven years of service, the pavement is in excellent condition.

Kind of Traffic

For a time after this street was paved it carried but little traffic, because the streets connecting with it were not improved. When traffic did come on Partridge Ave. from connecting streets, it tracked sand and dirt onto it—a severe test on the asphalt pavement.

For the past several years Partridge Ave. has received the usual amount of traffic, including passenger busses and other heavy vehicles.

A recent survey of the street by engineers established the fact that the asphalt pavement, taking everything into consideration, was in exceptionally good condition, and there is no question but that the pavement will give many years of splendid service. The surface of this street, after seven years of use, is as near perfect as any asphalt street can be.

> Asphalt, it should be remembered, is a cement to cement together the mineral aggregate. The cementing value of asphalt—its ability to form a strong bond or cement between the minerals that go to make up the mixture—is the real test of its quality

In this respect Stanolind Paving Asphalt is unexcelled. It possesses the properties which make it ideal for street paving.

The services of our staff of road engineers are always at your disposal. This service, which is free, is of inestimable value. We invite you to avail yourself of it.

STANDARD OIL COMPANY
(INDIANA)
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Gardner Governor Co., Quincy, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Indiana Air Pump Co., Indianapolis, Ind.
Lawrence Machine Co., Lawrence, Mass.
Le-Courtenay Co., Newark, N. J.
McGown Co., J. H., Cincinnati, O.
Myers & Bro. Co., F. E., Ashland, O.
Nordberg Mfg. Co., Milwaukee, Wis.
Northern Fire Apparatus Co., Minneapolis, Minn.
Novo Engine Co., Lansing, Mich.
Rumsey Pump Co., Seneca Falls, N. Y.
Weinman Pump Mfg. Co., Columbus, O.
Worthington Pump & Machy. Corp., New York.
Yeomans Bros. Co., Chicago, Ill.

PUMPS, SEWAGE
*Pacific Flush Tank Co., Chicago and New York
Sanitation Corp'n., New York.
Yeomans Bros Co., Chicago, Ill.

PUMPS, TAR AND ASPHALT
*Kinney Mfg. Co., Boston, Mass.

RADIATORS FOR GASOLINE ENGINES
*McCord Radiator Mfg. Co., Detroit, Mich.
Fedders Mfg. Co., Buffalo, N. Y.
G. & O. Mfg. Co., New Haven, Conn.
Harrison Radiator Wks., Lockport, N. Y.
Modine Mfg. Co., Racine, Wis.
Racine Radiator Co., Racine, Wis.

RAILS AND RAIL JOINTS
*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Easton Car & Const'n Co., Easton, Pa.
Sweet's Steel Co., Williamsport, Pa.

RAILROAD DITCHERS (See Excavators, Ditch and Trench.)

RECORDERS, WATER STAGE
Builders Iron Fdry., Providence, R. I.
Gurley, W. & L. E., Troy, N. Y.

REFRIGERATING MACHINERY. (See Ice Making Machinery.)

REINFORCING, CONCRETE. (See Concrete Reinforcement.)

RIVETERS, PNEUMATIC
Alliance Machine Co., Alliance, O.
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Hanna Eng. Works, Chicago, Ill.
Helwig Mfg. Co., St. Paul, Minn.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Watson-Stillman Co., New York.

RIVET SETS
Cleveland Pneumatic Tool Co., Cleveland, O.
Dunbar Drop Forge Co., Chicago, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.

RIVETS, BRIDGE AND STRUCTURAL. (See Bolts, Nuts, Etc.)

ROAD GRADERS
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Hadfield-Penfield Steel Co., Bucyrus, Ohio
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Shaw-Enochs Tractor Co., Minneapolis, Minn.
*Stockland Road Mach. Co., Minneapolis, Minn.
*Western Wheeled Scraper Co., Aurora, Ill.
Adams & Co., J. D., Indianapolis, Ind.
Case Threshing Machine Co., J. I., Racine, Wis.
Galion Iron Works & Mfg. Co., Galion, Ohio
Gilbert Mfg. Co., Aberdeen, S. D.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Monroe & Sons, N. S., Arthur, Ill.
Owensboro Ditcher & Grader Co., Owensboro, Ky.

ROAD OILS. (See Oils, Road.)

ROAD OILERS
*Austin-Western Road Mchy. Co., Chicago, Ill.
*Connery & Co., Philadelphia, Pa.
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*Kinney Mfg. Co., Boston, Mass.
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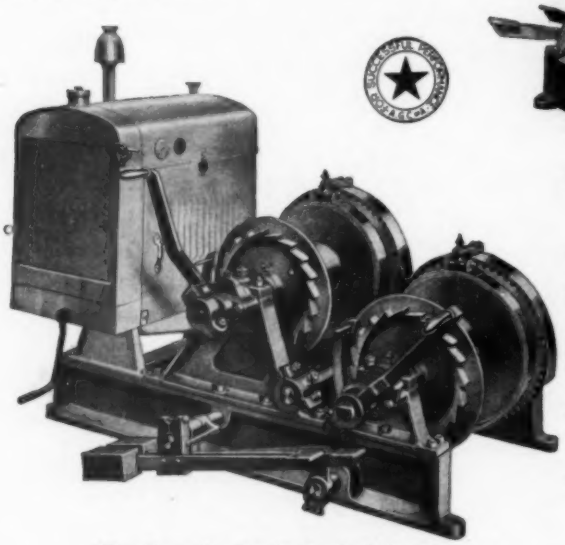

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*Littleford Bros., Cincinnati, O.
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Birmingham Tank Co., Birmingham, Ala.
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Graver Corporation, E. Chicago, Ind.
Indiana Air Pump Co., Indianapolis, Ind.
Ingersoll-Rand Co., New York.
Lancaster Iron Wks., Lancaster, Pa.
National Tube Co., Pittsburgh, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Scaife & Sons Co., W. B., Pittsburgh, Pa.
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*Littleford Bros., Cincinnati, O.
Biggs Boiler Wks., Akron, O.
Birmingham Tank Co., Birmingham, Ala.
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Case Threshing Mach. Co., J. I., Racine, Wis.
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Chicago Bridge & Iron Works, Chicago, Ill.
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Fouts Co., C. C., Middletown, O.
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Pacific Tank & Pipe Co., San Francisco, Cal.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Riter-Conley Co., Pittsburgh, Pa.
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United Iron Works, Inc., Kansas City, Mo.
Walsh & Weidner Boiler Co., Chattanooga, Tenn
Wayne Tank & Pump Co., Ft. Wayne, Ind.

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Davis & Son, G. M., Palatka, Fla.
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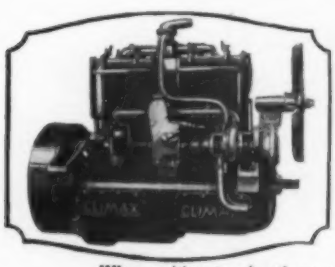

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TRENCH EXCAVATORS, (See Excavators Ditch & Trench)

TRENCH PUMPS. (See Pumps, Contractors')

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Eddy Valve Co., Waterford, N. Y.
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Kennedy Valve Mfg. Co., Elmira, N. Y.
Rensselaer Valve Co., Troy, N. Y.
Smith Mfg. Co., A. P., East Orange, N. J.
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Clark Co., H. W., Mattoon, Ill.
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Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Co., Waterford, N. Y.
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Iowa Valve Co., Oskaloosa, Ia.
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Features of Widening Albany Street Bridge, New Brunswick, N. J.

Contractor Used Minimum Equipment and Kept Heavy Traffic Moving

By W. F. Borden

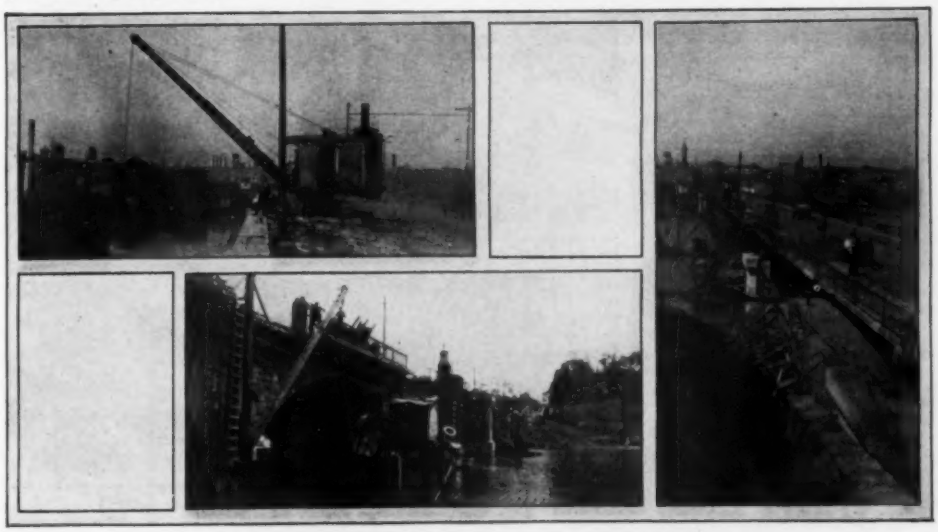
Resident Engineer, Bridge Department, New Jersey State Highway Commission

THE old Albany Street bridge, which carries heavy traffic between New York and all points south through New Brunswick to Philadelphia, was 750 feet long and consisted of three spans of structural steel, one of which was a bascule lift-span supported on piers of stone and concrete masonry which formed the bridge over the canal. This structure continued eastward as seven earth-filled arches of bridge masonry faced with cut stone supported on piers of stone masonry. The total length of the bridge and approaches was 1,630 feet.

This structure carried a paved roadway 24 feet wide with two trolley-car tracks and a 10-foot 8-inch sidewalk on either side, giving a total width of 45 feet. The approaches on both the New Brunswick and Highland Park sides consisted of earth fill supported on retaining walls of stone masonry on either side of the roadway.

Need for Widening and Strengthening Bridge Structure

The rapidly increasing heavy truck traffic which is using this route in both long and short distance



WIDENING AND BACKFILLING OPERATIONS

Above.—Erie crane excavator backfilling behind new walls of bridge. Below.—Excavating for widening of Pier 4 on the south side of the Albany Street Bridge. At right.—Erecting spandrel wall forms on Arch No. 7 in April, 1924

hauling, the scouring of several of the foundations of the bridge piers which were carried on wooden cribbing, and the deplorable condition of the roadway necessitated general reconstruction.

Some of the difficulties with which the contractor was faced may be appreciated when it is realized that this bridge, in addition to carrying a constant stream of heavy traffic, carried the Public Service Electric Company's electric power and lighting conduits and gas pipe, as well as the cables of the New York Telephone Company, the Western Union Telegraph Company, and the Postal Telegraph Company, all of which are main trunk lines. Further, the Raritan River is subject to flood conditions both spring and fall, which made it necessary to get the foundation work out of the way before the projected cribbing might be endangered by flood conditions.

Outline of Work

The reconstruction project called for the widening of the total structure from 45 feet to 61 feet. A portion of the retaining walls and spandrel walls on the south side of the structure were removed, as well as a portion of the decks of the three steel spans; the masonry piers, arch rings and abutments were extended, and new retaining walls and spandrel walls were constructed, together with a partial new deck on the three steel spans over the canal. The extension of the arch rings and piers was filled with earth and broken stone, forming a compact subgrade for the paving and walks.

The concrete sidewalk and curb and iron guard on the north side of the structure were not disturbed except on the west approach, where they were rebuilt. The concrete subwall on the north curb line was removed by cutting it near the surface of the old sidewalk and removing both the concrete and the pipe railing.

The entire roadway was repaved with granite block pavement bonded with asphalt. The Michael Staub and Kolyn Construction Company, 207 Commonwealth Building, Trenton, N. J., the engineers and contractors on this job, made all the necessary changes in the relocation of the electric light poles, conductors, conduits, drains, catch-basins, and sewers.

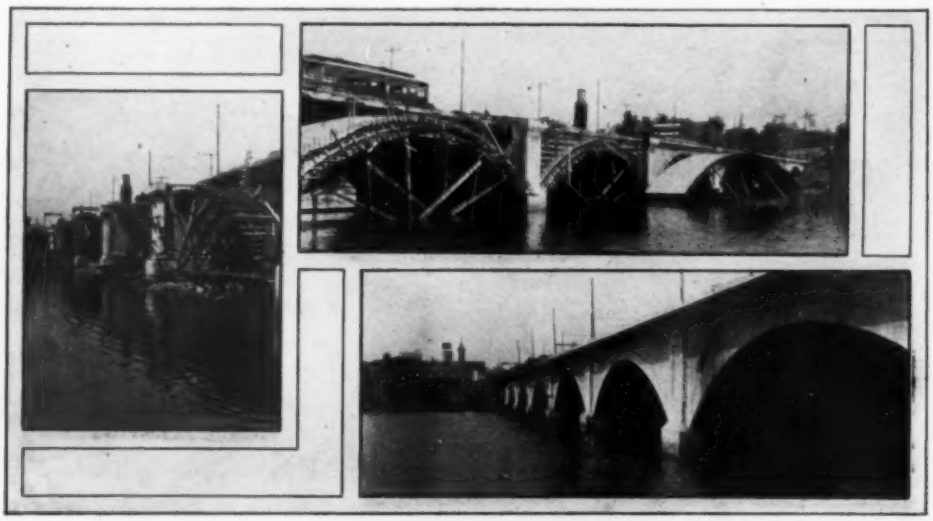
Another of the many problems which were successfully solved was the maintenance of one-way traffic on the tracks of the Public Service Railway Company at all times. There were two trolley-car tracks on the bridge, one of which was always in service.

The West Approach

The west or New Brunswick approach is about 140 feet in length. The work on this section of the job consisted in removing the stone retaining wall and constructing a new concrete retaining wall. This necessitated the removal of a frame bridge house and a portion of the back of two brick buildings, which were repaired to the satisfaction of the owners. In performing this work an existing 48-inch brick sewer had to be safeguarded. This sewer was extended on the east end with a 48-inch concrete sewer which emptied into the Raritan Canal.

The Two Fixed Steel Spans

The two fixed steel spans, each about 65 feet in length, had two deck girders in each span. The decks of these spans were of reinforced concrete. The concrete was cut in such a manner as to leave the transverse reinforcing rods bare and projecting so as to form a bond with the new deck. The cut was made inside of the south girder in order to release that girder, which was moved to a new position about 15 feet south, and a new girder was placed in the location of the one which had been moved. Following this, the entire superstructure of the two spans was raised about one foot above



THE ALBANY STREET BRIDGE UNDER CONSTRUCTION AND AS COMPLETED

At left.—Blaw-Knox centering in place ready for lagging. At top.—Moving arch centers on float from Arch No. 4 to Arch No. 1. Below.—Arch forms and sidewalks completed July 30, 1924. The arches measure 85 feet between spring lines, with a 14-foot, 6-inch rise. Each arch ring contains 132 cubic yards of concrete and 9,751 pounds of reinforcing

MIXING AND PLACING CONCRETE ON ALBANY STREET BRIDGE

At right.—Koehring mixer, stiff-leg derrick, and one of the two Ford one-ton trucks which handled as many as 20 batches of concrete per hour in heavy traffic. At left.—Depositing concrete on top of spandrel

the former elevation, to conform to the new grade of the roadway.

The south side of the two fixed steel spans was carried on cribbing built up from the top of pilings during the construction work. This piling was driven from a special derrick boat built on the job for the low work. The cribbing had to carry the entire south portion dead load, trolleys, and vehicular traffic live loads until the new steel was in place and connected up, or for a period of about one week.

The new reinforced concrete deck was securely bonded to the old deck and extended so as to complete the structure to the required extended width. To effect the raising of these two steel spans, which weigh a total of about 500 tons, eight hydraulic jacks were used. Both spans were raised at one time, the work being done between one and six in the morning. During this period, when traffic is always light, no vehicles were permitted to cross this bridge, this being the only time that the structure was closed to traffic during the entire job.

The Bascule Lift-Span

The old bascule lift-span was about 60 feet in length and formed the opening for water traffic on the Raritan Canal. It consisted of two plate girders supporting a wooden floor paved with wood block. This span was widened and necessarily extended about 10 feet to take care of the skew. Its treatment in general was similar to that of the two fixed steel spans as described above.

The alteration of the lift-span necessitated the cutting away of a considerable portion of the old concrete counterweight and also a part of the concrete deck of the adjacent fixed span, to make it possible to get at the counterweight. A wooden deck was built over this portion to carry traffic during the structural work on the bascule span. The Raritan Canal was closed for a month during this work.

The bascule lift-span was cribbed up on both the north and the south side under the entire structure, this being necessary because the span had to be raised bodily 14 inches after the jacks were in place. All rivets and bolts were removed before the jacking was started. The 14-inch lift of the draw-span took just 55 minutes, while the making fast and bolting up, raising the trolley tracks adjacent to the draw on both sides for a distance of 25 feet, and planking over the counterweights for vehicles, all consumed five hours.

The Seven Arch Spans

Each of the seven consecutive brick arches over the Raritan River were 85 feet in length. The piers and foundations on which they were supported were extended on the south side about 17 feet with plain concrete masonry. The arch rings, spandrel walls, counterforts and sidewalks of the new portion of the structure were built up of reinforced concrete thoroughly bonded to the old cut stone facing of the existing structure. The extrados of the extension of the arch ring at the back of the new spandrel wall were covered with fabric waterproofing, which was extended upward over the face of the old cut-stone facing of the arches so as to form a flashing 12 inches high.

All of the old earth filling was retained and more earth filling with broken stone was added to bring the subgrade up to the proper level for the roadway and sidewalks.

The stone masonry on the existing eight piers on which the arches were supported has been protected by an extra covering of concrete 18 inches thick, bonded to the stone masonry by a system of reinforcing rods. This protection was extended from the spring line to the bottom of the old foundation masonry.

The East or Highland Park Approach

The approach on the east side of the structure is 700 feet in length. The old stone retaining wall and steps on the south side were removed and new concrete retaining wall constructed about 13 feet south of the existing one. The new work consisted of building a flight of concrete steps and replacing the roadway paving with new granite blocks.

How the Work Progressed

The contract for this entire job was awarded on December 19, 1923, and work actually began on December 27, 1923, when the contractor started excavating and removing the old wall on the east approach. An Erie steam shovel was used for the excavation on the east approach, with three White trucks hauling away the spoil. An Ingersoll-Rand compressor and three drills were used in breaking down the old wall and drilling the rock. About the middle of January some blasting was carried

on in removing rock on the east approach. About the same time wet excavation with the clam-shell bucket began on the piers. As much excavation as possible was handled before the coffer-dam frames were set. Following this, Lackawanna sheet steel piling was driven, using a Vulcan steam pile hammer. This work was continued day and night, as it was considered necessary to get the job out of the way as quickly as possible.

The total adjusted cost of the bridge was $400,000. The first estimate allowed on January 20, 1924, was $24,190.76.

Building Up the Arches

Each old brick arch was widened about 17 feet with a new concrete section that was built up on Blaw-Knox steel centering which was cribbed up on the spring line of the arches. The centering was floated in and out of position on the tide. This made it necessary to do a considerable portion of the work during twilight. The arches have a span of 85 feet and a rise of 14½ feet.

Concrete Encasement of Old Piers

The first work done on the piers was the placing of the new foundation on the side where the widening took place. This consisted of 1:2:4 concrete placed in the dry within the coffer-dam built up of Lackawanna sheet steel piling. Following this, the 18-inch encasement around the old pier was carried out similarly in the dry. The foundation of the widened portion was bonded to the old by carrying the horizontal reinforcement of the 18-inch concrete encasement into the body of the concrete.

The 18-inch encasement concrete was bonded to the old pier by anchor bolts. The encasement was carried out in the form of a wedge with a steel angle at the apex to form an ice-breaker on the north side of the bridge.

Reconstruction of Bascule Span

A stiff-leg derrick had to be built at the side of the structure and the legs held with old granite paving, because the roadway could not be obstructed with any equipment of this type. This stiff-leg derrick handled all of the steel work for the widening of the bascule span. Special piling had to be driven to carry the derrick, and then, following the completion of the work, the piling had to be pulled.

Because of the constant jarring of the bridge structure by traffic during all the work, it was impossible to use a transit on the structure to line up the three trunnions, so the engineers reverted to the old 3-4-5 right triangle to set the line of the two outer trunnions and to line up the main trunnion bearing, and then placed the third trunnion, which was 17 feet from the southerly bearing, by stretching a wire across the centers of the outer bearings. Particular mention should be made of the work of Albert Mattson, General Superintendent for the contractors, and Howard Glenn, Assistant Superintendent in this work, as well as their fine spirit of cooperation throughout the entire project.

The reconstruction necessitated the lowering of the main counterweight pins. In order to do this, the counterweight itself had to be shored up, and while the pin was lowered only 2¼ inches, this was one of the most delicate pieces of work connected with the entire operation. A special cutting reamer had to be devised to cut out the bearing in the main sheet to exactly the proper depth.

So well was this work on the bascule handled that when the Straus Bascule Bridge Company's representatives inspected the bridge at the completion of the work, it was found that the enlarged lift-span could be raised in 61 seconds and lowered in 62 seconds, and fitted accurately, and used the same quantity of current for raising and for lowering the span, showing the perfect balance of the structure and the excellent alignment of all bearings.

Atlas Lumnite cement was used in pouring the new portion of the counterweight. Considerable experimenting was necessary to secure the necessary weight of concrete, which was 250 pounds per cubic foot. A 1:1:1:1½ mix was found necessary to secure this required weight. This is the first time that this kind of cement has been used in bulk.

Quantities of Materials

In the reconstruction of the Albany Street Bridge, 6,000 square yards of old granite block paving were removed, 7,000 square yards of new granite block paving laid, 6,000 yards of new 6-inch concrete base were laid, and a total of 8,000 cubic yards of concrete used in the entire project. Ninety tons of Havemeyer reinforcing steel were used, and 115 tons of structural steel. The earth excavation amounts to 3,000 cubic yards, the rock excavation 3,500 cubic yards, and the back-fill 3,500 cubic yards.

The time of completion specified in the contract was 225 working days. Because of delays over which the contractor had no control, the state granted a 40-day extension, making an adjusted number of days for completion of 265. At the end of this time the entire work was 100 per cent completed and all equipment removed from the site.

Contractor Not a Guarantor of the Owner's Defective Plans

A Limitation of the Builder's Responsibility

A BUILDING contractor is not responsible for collapse of a structure where he has erected it according to plans and specifications provided by the owner, holds the New Jersey Court of Errors and Appeals in the case of Hammel vs. Van Sickle, 128 Atlantic Reporter, 247. Concerning a contractor's responsibility for the falling of a garage, the Court approved the following statement made by a lower court:

"It appears that the plaintiff had submitted a sketch. When the defendant constructed the building of the materials and in the manner called for by it, his duty to the plaintiff was at an end. It was not his duty to pass upon the sufficiency or fitness of the building for the uses to which the plaintiff intended to build it. This was the plaintiff's responsibility when he provided the sketch. As was said in the case of Drummond vs. Hughes, 91 N. J. Law, 563, 104 A. 137: 'Plaintiff was entitled to the house he bargained for and not a better house'."

Bubbles and Wires Cause Troubles

Too Great Refinement Gets on Instrument Man's Nerves on Many Building Jobs

By J. O. Preston

Warren-Knight Company, Philadelphia, Pa.

THERE are a great many building contractors trying to force instrument men on foundation jobs and building construction to use levels and transits that would do credit to a geodetic survey party or a railroad outfit taking 1,000-foot shots. These instruments have very sensitive bubbles which jump all over the place when the steam shovel or riveting hammer cuts loose near-by; and the cross-wires on the engineer's level are so fine that it is difficult to use them on near shots. The engineer using them for long distances out in the open needs a fine wire because a coarser wire would intercept too much space on the stadia rod. On the other hand, heavy wires in the telescope are an advantage on building construction, as they can be easily seen.

It is not good business to use the instrument for long shots as well as close-up work. The contractor should have an instrument specially designed for the particular kind of work he is undertaking. If the contractor would write or go to a reliable maker of transits and levels and tell him the purpose for which he needs an instrument, the manufacturer would give him advice on the proper degree of sensitiveness of the level bubble required for that particular service. Frequently, however, after it is too late the contractor discovers that the old transits or levels which he has bought are awkward because of their supersensitiveness, require more skill to handle and are expensive to adjust and repair. Not only is time and money wasted because of the improper degree of sensitivity of the level vial, but there are many cases where a complete surveyor's transit is not required and, in fact, its use is an unnecessary risk because it is too complicated and involved for the big-fisted foreman. For general construction work the contractor should secure an instrument which is a good level with the level vial at the proper sensitivity for his type of construction work and also with the essential features of the builder's transit. This type of instrument is popular with construction foremen not only because it is simple to operate, but also because there is less expense involved in case of accident. In addition to being a reliable level, it can also be used to quickly plumb columns, end posts on buildings, etc., extend lines and also set points exactly between two known points. The instrument will turn horizontal angles to an accuracy within five minutes. These things cannot be done with an engineer's level.

Price is the basis on which many builders and contractors invest in levels and transits. Comparatively cheap new instruments are usually not made of the proper material and are affected too easily by changes in temperature. On account of pride, when a man has bought an instrument, he usually sticks to it, even though it is somewhat of a disappointment. In making a purchase of this type, a contractor should not close his eyes to everything but price, and when he finds an instrument unsatisfactory, he should throw off his pride as well as the instrument which he has bought unwisely.

The sweet and temporarily satisfying song of low price never equals the bitterness of low quality. Haven't you found when you purchase something at a slightly higher price, that when you shop around you can usually purchase something apparently as good at a lower price? In the majority of cases, however, when you shop around with a price specification and with little other information, you find that you have not only wasted your time but made a poor bargain as well. Price is not everything; quality is an essential, but be sure when buying a level or transit that you secure one which is built for the type of job you intend to use it on.

The All-Western Road Show

Great Interest Is Already Evident in Show to Be Held in San Francisco November 9-14

THE All-Western Road Show which is to be held in San Francisco November 9-14, 1925, under the auspices of the Western Construction Equipment Distributors, is arousing great interest throughout the western portion of the United States. Preparations are being made for 10,000 visitors, and large delegations of contractors, supervisors, county commissioners, engineers, and municipal officials are coming from every point in the western third of the country to take in this first large show of road-building, excavating, and quarry equipment ever held in the West.

A separate day during show week is set apart for each group of visitors to the show—Tuesday is to be Engineers' Day, Wednesday Supervisors' Day, Thursday Contractors' Day, and Friday Dealers' Day. Conventions on the show grounds will be held on each of these days, and in addition to viewing the machinery exposition, visitors will have a chance to meet others in the same line of work and profit by a mutual discussion of their problems.

The Executive Committee, consisting of Edward R. Bacon, of Edward R. Bacon Company, Charles A. Spears, of the Spears-Wells Machinery Company, and P. H. Curtis, of the *Western Highways Builder*, announce that they have received orders for exhibition space from most of the leading manufacturers throughout the country, and ground plans provide for nearly 100,000 square feet of space for exhibits alone. Eighteen acres of the site of the Panama-Pacific International Exposition in the Marina in San Francisco have been engaged for the show, and ample room is thus provided for the standing exhibits under canvas as well as for the demonstration show in the open.

The Finance Committee, consisting of T. W. Harron, of Harron, Rickard and McCone Company, and G. T. Alm, of the Coast Road Machinery Company, are receiving applications.

Why Wire Rope Can't Be "Bad" in Spots

By B. T. Macy

AN idea that prevails to quite an extent among wire rope users is that a rope may be bad in spots and good a short distance from such spots. They probably make the mistake of thinking of wire rope in the same terms as manila or hemp ropes, which are made of short vegetable fibers, varying from one inch to six feet in length. The making of wire rope is altogether different, and the chances for imperfections and bad spots in the wire, or the finished rope, are practically eliminated in the course of manufacture.

A brief review of the process of manufacturing wire cable will show how difficult it would be to assemble a number of long wires of small diameter so that defective spots (if any existed in the individual wires) would appear together within a short space in the finished cable.

To start with, a steel of proper analysis is cast into a heavy ingot. After suitable heat treatment, this ingot is rolled between many reducing rollers, and as the metal becomes elongated into bars, these bars are cut into shorter lengths, called billets. Only billets of proper texture and properties are passed to the wire mill for drawing into rope wire. The billet is considered the raw material of the wire mill.

The billet is a bar of steel about 4 feet long and 4 inches square, weighing about 300 pounds. This billet, while hot, is passed through twenty to thirty more reducing rolls until it is reduced to a rod or wire about 3/16-inch in diameter and about ½-mile in length. From this 3/16-inch size wire rod the work of reducing the wire to proper size for rope wire is done by drawing the wire through a number of steel dies with holes slightly smaller in diameter than the wire. This operation of reducing the wire is done while the steel is cold. As the wire becomes smaller, each reduction is but a few one-thousandths of an inch, and it takes many such small reductions and handling to produce wires of proper quality and size for small-diameter wire ropes.

After each drawing operation the wire is tested for various properties to see if it will stand further working. If the test is satisfactory, the wire is then heat-treated and cleaned and allowed to cool for the next reduction. If, on the other hand, the wire shows negative properties for use as rope wire, the wire is rejected for further development in the rope mill, and is used for manufacturing cheaper grades of market wire. None of the wire not suitable for rope wire is wasted, as there is a demand for all grades of wire.

Individual wires in a small cable, say 5/16-inch diameter, are quite small. A single wire, one mile in length, of the size used in 5/8-inch diameter rope, would weigh but 15 to 20 pounds, while we started with a bundle of large size wire weighing about 300 pounds. This large bundle of wire has now been reduced to many smaller bundles weighing from 30 to 75 pounds each.

The next operation in the manufacture of a 6 x 19 cable, for example, is to wind these small coils of wire on spools. Nineteen of these spools are then set in a spinning or twisting machine. The product of this machine is what is known as strand. This 19-wire strand is wound on six larger spools. These six spools containing strand, together with a spool containing a hemp center, are now placed in a larger machine which twists or lays the six strands and hemp center together to make up the size of 6 x 19 construction cable for which these strands were designed. The finished cable is usually wound on reels containing from 5,000 to 10,000 feet. Again, before the cable is shipped to users it must be unreeled, measured, cut, and rewound for shipment. Thus, many eyes inspect all processes of manufacture as well as the finished rope.

It is quite apparent from the foregoing that an analogy between a hemp and a wire rope fails. Each wire in a wire rope is thousands of feet, and sometimes miles, long, and if we consider the number of times the steel was handled and treated from the ingot produced by the furnace, to the finished wire in the rope mill, and then consider that the wire during the process of manufacture has been carefully tested many times at both ends, it is hard to conceive how any considerable number of 114 wires in the rope could show defects. It is still more improbable, or we may say, impossible, that defective spots in a number of wires could localize to such an extent in the finished rope as to produce what is termed a "bad spot" in either a strand or a complete rope.

Any user of wire rope who finds a number of broken wires or excessive wear in spots on his cable should look carefully into the conditions under which the rope is operating, as he will generally find that some local condition is responsible for this wear.

To locate the cause of such localized wear, the operator should carefully mark the spot with white lead or red lead, or pull some waste through the broken wires; then the frayed ends of the waste will mark this spot in a manner so that it can be followed through an entire cycle of operation. The operator should be careful to notice where this spot on the cable is located on the machine during the cycle of operation when the greatest stress is on the cable. Quite often the operator will be able to locate a defective sheave, poor alignment, crowding of the cables on the drum, or obstruction in the path of the cable, which causes this localized wear.

Spots are sometimes caused by accidents or damage to the cable, and therefore the cause would not be discovered by normal operation of the wire rope. If the cause for these spots is discovered but for some reason or another cannot be removed, because of the pit or operating conditions, the life of the cable can often be prolonged by changing the cable end for end, or by changing the connections of the cable, or by shortening the cable so as to bring the bad spot of the cable away from the cause, thereby distributing the severe wear or abrasion to another part of the cable.—*Sauerman News.*

Legal Points for Contractors

These brief abstracts of court decisions in the contracting fields may aid you in avoiding legal difficulties. Local ordinances or state laws may alter the conditions in your community. If in doubt, consult your own lawyer

Edited by A. L. H. Street Attorney-at-Law

Contractor's Right to Rescind Agreement for Owner's Default

Where contractors are prevented by the owner's conduct from duly completing the contract, and are themselves without fault, they may sue for damages for breach of the agreement, or cancel the contract and sue for the value of the work done under it, holds the Maryland Court of Appeals in the case of Hipple vs. Mason, 127 Atlantic Reporter, 385. The Court said:

"If he [the owner] in fact committed a breach of the contract by failing to pay earned amounts to which the contractors were entitled, and by ordering them [the contractors] to leave the work because of their disagreement on that subject, there is no just reason why any provisions of the contract thus rescinded should be available as a ground for defense to a claim for labor and materials furnished at the owner's request in the improvement of his property."

Contractor's Responsibility in Obstructing Public Ways

Despite the fact that a street may be temporarily closed to general traffic in the performance of construction work, a contractor must anticipate reasonable use of the street and exercise reasonable care to avoid injury to persons so using it, holds the Connecticut Supreme Court of Errors in the late case of Wright vs. Blakeslee, 128 Atlantic Reporter, 113.

Defendants were paving one-half of a street, and that part was closed to vehicular traffic. But street cars were operated along the center of the street and persons alighting at a regular stop were required to pass along part of the street under construction. Plaintiff, while so passing in the night-time, tripped over a water pipe which had been left across a sidewalk. Sustaining judgment in plaintiff's favor the Court said:

"Defendants' . . . sole duty, they maintain, was to exercise reasonable care to place such warnings or barriers in the vicinity of the street on which they were working as would warn the public that the street was closed to traffic. . . .

In fact, it was open as to passengers alighting from trolley cars. Likewise the claim that the plaintiff who went upon a highway closed for traffic and undergoing repair did so at her own risk is predicated upon the fact that Campbell Avenue was a closed street, which was not the fact. The [trial] court's instruction that the defendants owed to the plaintiff 'the duty of using reasonable care in the performance of the work that they were carrying on, so as not to create and maintain an obstruction upon the sidewalk that was a source of danger, or likely to prove a menace, or cause an injury to persons who are lawfully using such highway, and who are in the exercise of due care,' was correct under the circumstances of this case."

Validity of Claim Against Contractor for Breach of Contract

An owner suing for damages for failure of a contractor to construct work according to contract must specify the particulars in which the contract has been broken, held the Texas Supreme Court in the case of Boettler vs. Tendick, 5 Lawyers' Reports Annotated, 270. In this case, plaintiff sued on a building contractor's bond and recovered judgment in a lower court, but the judgment was reversed because the trial judge erred in refusing to require plaintiff owner to specify in what particulars the contract had been broken. The Supreme Court said:

"The petition did not allege wherein appellant had failed to do the work in a workmanlike manner, as required by the contract, nor did it allege wherein appellant had failed to use such material as was called for by the contract, but did allege that it was discovered, after the building was received, 'that said foundation was not built and constructed in a thorough and workmanlike manner, nor was the material used therein in accordance with the specifications in said contract'; and 'that during the progress of repairs other defects were discovered in the said building caused by bad workmanship and faulty material used by defendant in the construction of said house, and the front walls and other portions thereof are permanently damaged.' . . .

"It was the right of the defendant to be informed wherein the workmanship was faulty, or the material furnished by him not such as his contract required; and when, by specific exception, he pointed out the want of more specific averment and sought further information as to the many facts on which the plaintiff relied for a recovery, he should not have been forced to go to trial until this information was given."

Contractor's Responsibility for Results of Inclement Weather

As to the right of a contractor to be freed from responsibility for defects in a building, due to weather conditions, the Iowa Supreme Court said in the case of Brent vs. Head, Westervelt & Company, 115 Northwestern Reporter, 1106:

"If it were to be conceded that the season had something to do with the faulty construction of the foundation, the plaintiff undertook to erect the buildings at that particular season, and to do a first-class job. There was no provision in the contract whereby he was relieved from protecting his work or material from the effects of freezing weather, and he cannot now claim that he should be released from liability because thereof. The evidence conclusively shows that buildings may be erected at any season of the year if proper steps be taken to protect the material and construction work; and that such is the case is matter of almost common knowledge."

Waiver of Defaults Under Construction Contracts

"If the builder has done a large and valuable part of the work [under a contract], but has failed to complete the whole or any specific part of the building or structure within the time limited by his covenant, the other party has the option, when the time arrives, of abandoning the contract for such failure, or of permitting the party in default to go on," declared the highest court of the land in the case of Phillips & Colby Construction Company vs. Seymour, 91 United States Reports, 646. "If he abandons the contract, and notifies the other party, the failing contractor cannot sue on the covenant [contract] and recover, because he cannot make or prove the necessary allegation of performance on his own part. What remedy he may have" by way of claim for the reasonable value of work and materials furnished "we need not inquire here; but if the other party says to him, 'I prefer you should finish your work,' or should impliedly say so by standing by and permitting it to be done, then he so far waives absolute performance as to consent to be liable on his covenant for the contract price of the work when completed.

"For the injury done to him by the broken covenant of the other side, he may recover in a suit on the contract to perform within time; or, if he wait to be sued, he may recoup the damages thus sustained in reduction of the sum due by contract price for the completed work."

Withholding Monthly Payments as Excuse for Contractor's Delay

"Where a building contract, in which there is a damage clause for non-performance by a certain time, provides for payment by the owner of monthly estimates, any delays caused by the wrongful withholding of the same are excusable," declared the Georgia Supreme Court in the case of Chamberlain vs. Booth & McLeroy, 70 Southeastern Reporter, 1223. But the same opinion holds that a contractor is not released from liability for delay in completing his contract unless the delay is caused by the owner's delay in making payments. And yet the opinion recognizes that the owner's delay in paying an installment due under the contract will give the contractor ground for rescinding his agreement and refusing to proceed with the work.

Proving Negligence on Part of Contractor

There is rule of law to the effect that where an accident occurs under such circumstances that it could not be expected to have occurred excepting through carelessness, negligence will be presumed without proof as to the specific cause of the accident. This rule, known under the maxim *Res ipsa loquitur* (the thing speaks for itself) constitutes an exception to the general rule that one suing for damages for an accident must prove in just what way defendant was at fault.

But in the case of Wolf vs. Downey, 164 New York Reports, 30, the New York Court of Appeals decided that where plaintiff was injured, through fall of a brick from a building in course of construction by defendants and other contractors, the mere occurrence of the accident did not establish negligence on defendants' part. The Court said:

"We agree with the court below that this is a case where the maxim, *Res ipsa loquitur*, applies. There is a presumption that the plaintiff's injury was the result of negligence. . . . But that presumption did not complete the proof which it was incumbent upon the plaintiff to make before the case could be submitted to the jury. In a case like this, where the building in process of construction is in charge of numerous contractors and their workmen, each independent of the other, and none of them subject to the control or direction of the other, some proof must be given to enable the jury to point out or identify the author of the wrong. There is no principle that I am aware of that would make all of the contractors or all the workmen engaged in erecting this building liable *in solido*. And yet there is just as much reason for that as there is for holding two of these contractors for no other reason than that one of them had charge of the carpenter work and the other of the mason work. The plaintiff, we must assume, suffered injury from the negligence of someone; but I am not aware of any ground, in reason or law, for imputing the wrong to the two contractors who are defendants, or for selecting them from all the others as responsible to the plaintiff, unless they can conclusively show that they are not. When there is no proof where the brick came from, except that it came from the building, and nothing to identify the person who set it in motion, it cannot be said that the plaintiff has made out a case for the jury."

Variations in Dimensions in Performing Contracts

One of the leading court decisions on the effect of a contractor's deviation from contract requirements specifying dimensions is that handed down by the United States Supreme Court in the case of Swain vs. Seamens, 76 United States Reports, 254. What the Court said concerning the dimensions of a sawmill may be applied to almost any sort of structure:

"It is not possible to decide as a conclusion of law that a sawmill 78 feet in width by 100 feet in length is a substantial compliance with an agreement which required that the sawmill to be constructed should be of the dimensions described in that instrument, even though it be shown that it cost more and was of greater value and better adapted to the purposes to be accomplished; as the appellant, having stipulated that the sawmill to be built should be 50 feet in width by 150 feet in length, had a right to stand upon the contract and to insist that it be fulfilled according to its terms.

"Substantial performance, it is true, is all that is required to satisfy such agreement, and it may also be conceded that in the adjudication of controversies growing out of building contracts, slight differences in the dimensions between the building constructed and the terms of the contract may, under many circumstances, be overcome by a reasonable application of that rule, but the differences in the case before the Court are far too great to fall within that principle, as the effect would be to make a new contract and substitute it in the place of the stipulation executed by the parties."

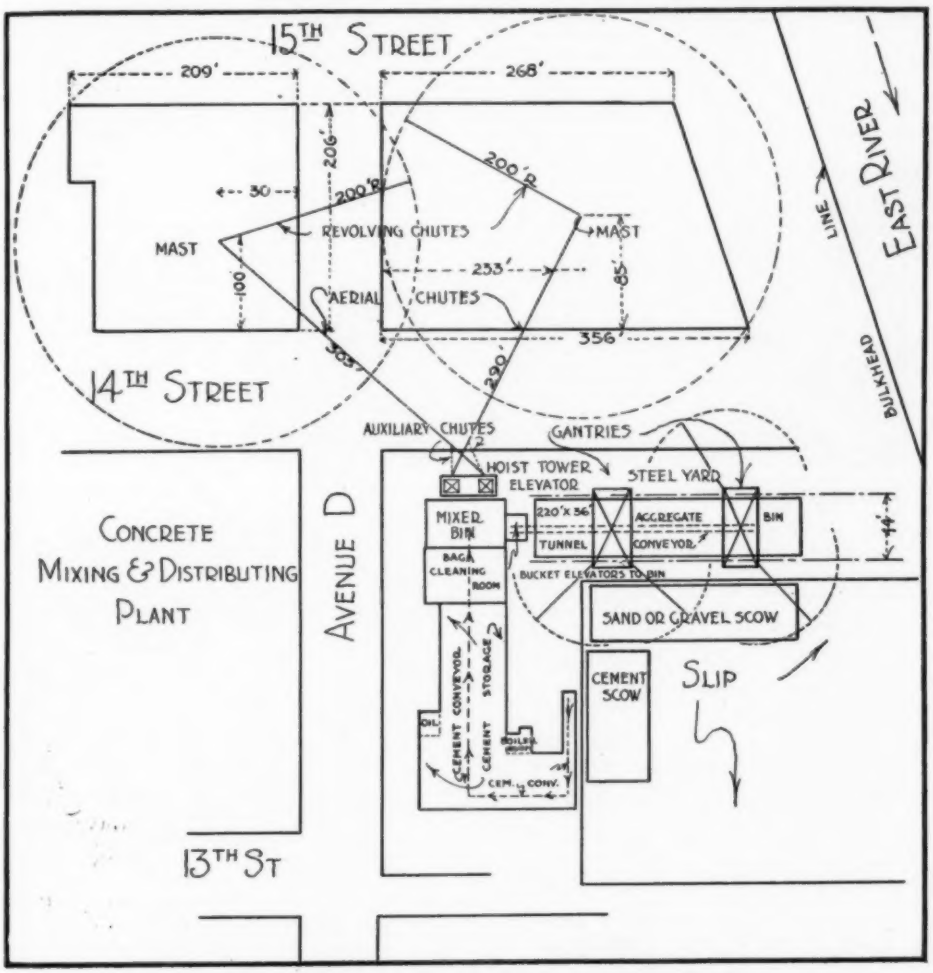
Building a Large Generating Plant

Rapid and Efficient Construction of Massive Soft Ground Foundations for a $25,000,000 Power-House Contract

ONE of the largest steam-turbine-driven electric generating plants ever built is now under construction at the foot of East 14th Street, New York, by the New York Edison Company. It will cover two full city blocks and will have an eventual capacity of 720,000 horse-power. The buildings now under contract for about $25,000,000 cover an area of nearly 600 x 300 feet, are 130 feet high, and have a continuous concrete footing 15 feet thick placed in successive 7-foot and 8-foot layers, in which are imbedded 400 pieces of 6-foot cast iron pipes for the condensation water, and many other pipes.

The concrete rests on a foundation composed of 18,000 untreated yellow pine piles, 12 to 14 inches in diameter and about 40 feet long, that have an average penetration of 25 feet to a stratum of coarse and stiff clay, where they were driven to a refusal often amounting to 100 blows for the last inch of penetration. The general contract was awarded to the Kenn-Well Contracting Company. The piles were driven by the P. T. Cox Contracting Company, subcontractors to the Thomas Crimmins Contracting Company, contractors for excavation and foundation.

As the approximately level surface of the ground here is only a few feet above mean high-tide in the adjacent East River, the ground was



PLANT LAYOUT OF THE EDISON EAST 14th STREET JOB

very wet and soft, so that it would have been impracticable to use steam shovels had it not been immediately drained, first by a system of surface ditches, pumped out by two Domestic gasoline-driven portable pumps and afterwards, as the depth of excavation increased, drained by trenches converging directly and by means of a wooden flume carried through a tunnel under Avenue D, to a special deep sump. The sump was excavated to a depth of several feet below subgrade and enclosed with open sheeting and broken stone outside so as to thoroughly drain the adjacent area and intercept much of the direct flow of ground water from the river. In it were installed two electrically driven 6-inch centrifugal Kingsford pumps, one of which usually sufficed, working part capacity, while the other was held in reserve.

The general excavation was handled at the rate of about 420 yards in one 8-hour shift by two steam shovels working in two successive lifts and delivering to a fleet of five to ten power dumping Mack trucks handled so rapidly and systematically that little or no waiting was involved. After completing the excavation, the shovels were equipped with 40-foot derrick booms and were used as locomotive cranes. Stones too large to be handled by the shovels were blasted after block drilling done with air from a Chicago Pneumatic Tool Company's portable gasoline-driven compressor having a capacity of 150 cubic feet of free air per minute and operating two jack-hammer drills.

Excavations below subgrade for the two condensation water tunnels was made by three Hayward clam-shell buckets, operated between the braces of the sheeted sides of the tunnel trenches and handled by derrick booms and by 50-foot steel booms installed in place of dipper booms on the steam shovels. This excavation, amounting to about 20,000 yards, was made simultaneously with the general excavation and with the pile driving adjacent to it.

In order to secure the greatest rapidity and economy in pile driving, there were installed two 28 x 38-foot wooden travelers moving from end to end of the lot on broad-gage tracks. Each traveler was equipped with two derrick booms at opposite corners. From each boom there were suspended leads, in which were operated four 9-B McKiernan-Terry double-acting steam hammers, striking 140 16-inch blows per minute with an energy of 7,727 foot-pounds per blow, and driving as many as 77 piles to a penetration of 20 or 30 feet in one 8-hour shift.

These travelers, with their long booms, were able to clear many obstructions and to work around other construction operations, driving as many as 1,100 of the closely spaced piles from one position of the traveler and moving to another position 100 feet farther away to repeat the operation. The traveler booms were also very convenient for handling piles and pile butts, and the use of the travelers eliminated the services of four of the men that would otherwise have been required to operate an equivalent number of ordinary land pile drivers.

Besides these travelers, there were installed two ordinary land pile drivers moving on rollers and skids and equipped with No. 2 Warrington-Vulcan steam hammers with 3,000-pound rams and 3-foot strokes that drove up to 67 piles each in one 8-hour shift. There were also installed two No. 7 and two No. 9-B McKiernan-Terry double-acting steam hammers that were used for general purposes and especially for driving about 40,000 square feet of 35-pound steel sheet piles for the tunnel trenches and vertical faces of the excavation. The sheet piles were up to 40 feet in length and were driven at a rate of about 70 units per day by the steam hammers, operated by derrick booms and locomotive travelers. All the steam hammers were handled by Lidgerwood hoisting engines, with which other derricks were also equipped, making a total installation of twelve 2- and 3-drum engines, some of them with swinging engines of the same type and having steam boilers that supplied the steam hammers as well.

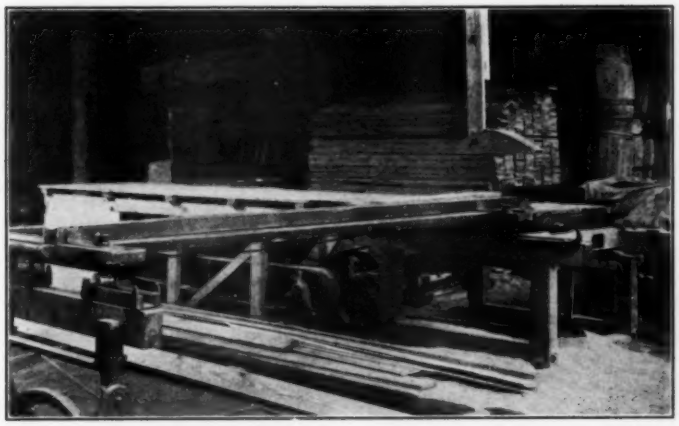
SPECIAL TRAVELERS DRIVING 1,100 FOUNDATION PILES EACH FROM EACH POSITION

The foundation piles were delivered by water, stored on catamarans and hauled to the site by motor trucks that deposited them close to the drivers. When the work was congested, they were placed in temporary storage. Piles were designed for 20-ton loading, and their capacity was carefully checked by the *Engineering News* formula, modified to allow for varying steam pressures in the double-acting hammers, and worked out in tables showing at a glance the value for piles where the penetration for the last ten blows varied between 3 and 6 inches.

About 800 tons of 14-inch Lackawanna steel sheet piles, 55 to 65 feet long, will be used by the Phœnix Construction Company for the cofferdams in which the bulkhead wall and screen chamber will be built. These will resist pressure heads up to more than 40 feet, and will probably be reclaimed substantially uninjured, giving them a high salvage value when the job is finished.

Material Handling

Before construction operations were commenced,

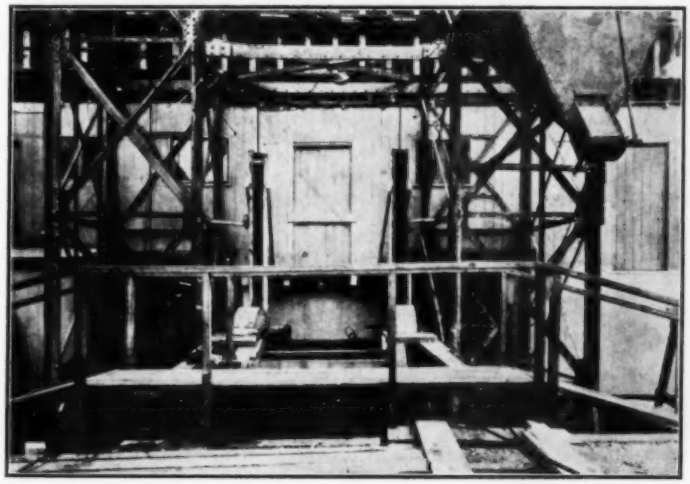


DOUBLE SAW FOR RIP AND CROSS-CUT WORK ON FORM LUMBER AND TIMBERING

comprehensive studies were made of the various systems for the most rapid, efficient and economical handling of materials and the placing of the very large amount of concrete that was distributed over an area more than 200 feet wide and 600 feet long on both sides of Avenue D, between 14th and 15th Streets. Various plans were made and comparative estimates were studied, and a combination of the best features in eight separate layouts was finally adopted, which provided for a system of movable unloading derricks, very large live storage of cement and aggregate, extensive conveyor systems to deliver cement and aggregate to the concrete mixer, and a system of aerial distribution for transporting the concrete from the mixer plant across the street and to all parts of the building area. This involved the expenditure of more than $60,000 for an installation that, although temporary, will be in service for many months, perhaps for several years, and, being composed of standard equipment, will have a high salvage value. The selection and arrangement of the equipment was determined by the general contractor's staff in conference with the R. E. Brooks Company and the Ginsberg-Penn Company, equipment specialists through whom some of the $60,000 plant was purchased. All important details of construction and installation were selected or designed in advance by the contractor's engineer and his staff.

The 1:2:4 concrete is made with 1,200,000 bags of Atlas portland cement and 200,000 yards of mixed aggregate consisting of two parts sand and four parts gravel up to 1½ inches, dredged on the north shore of Long Island, guaranteed free from loam, and furnished by the Kittanning Sales Company, New York. Aggregate is delivered on barges, unloaded by three Blaw-Knox clam-shell buckets, operated by four derrick booms mounted on two steel gantry travelers running over a hopper bottom storage bin, 36 feet wide, 17 feet high and 220 feet long, that is provided with bottom gates, delivering to a belt conveyor in a tunnel. The conveyor discharges into the boot of a bucket elevator that delivers to the elevated mixer bin, where a short distributing belt conveyor enables the operator to fill either of the three sections it contains at will.

Cement bags are unloaded from barges to a system of slat conveyors, and are delivered for



LOWER PART OF 240-FOOT TWIN HOISTING TOWER

The buckets are independently hoisted and lowered and are filled through automatically revolving chutes

storage in a shed of 25,000 bags capacity, or taken by it either from storage, or directly from the barge to the terminal platform. The bags are emptied and their contents chuted into the charging hoppers, while the empty bags are sent to the shaking machine, where about 1 per cent of the total amount of cement is reclaimed. The gates, conveyors and elevators in the system are of the Haiss standard type, operated by 6 interchangeable electric motors of 5, 10 and 15 horse-power.

Aggregate is delivered to the two mixer-charging hoppers through two Butler batchers, instantly operated by levers controlled by the attendant, who thus measures and delivers the aggregate with great rapidity and precision. Both storage and mixer bins are furnished with perforated steam pipes to prevent freezing. Concrete is mixed in two 1-yard Koehring machines, installed in the lower part of the tower that supports the mixer bin. They are driven 15 r.p.m. by 20-horse-power electric motors and by power-operated discharge through automatically clearing tip chutes into 1-yard buckets in a twin steel hoisting tower 240 feet high.

The buckets can discharge through a low-level hopper into motor trucks on the surface of the ground, but are generally hoisted in about 20 seconds to the top of the tower, where they discharge into hoppers, connected by swinging chutes with either or both of two 300-foot lines of inclined chutes suspended from aerial cables. These chutes discharge into circular hoppers on the masts of the 115-foot American Hoist and Derrick Company's steel derricks that rest on 20-foot wooden towers and are secured by eight lines of guy cables.

From each circular hopper the concrete is delivered to a 100-foot line of steel chutes, supported on the inclined top chords of two counterweighted trusses, carried by the mast and by its 100-foot steel booms. The end of the lower chute is supported on a light, movable steel tripod, and is supplemented by a short, hand-operated chute that enables the concrete to be placed at any required point in the footings. The hoisting towers, chutes and hoppers and trusses are of the Insley type.

The trusses are specially reinforced against the possibility of transverse impact, and the chutes are enclosed by tall, vertical angle-iron yokes, the sides of which carry panels of wire netting that prevent any spilling of the contents of the trough to the ground below. The yokes also carry hand lines for the safety of the men that travel back and forth over the chutes when required. Both mixers, running at capacity, together discharge a continuous stream of concrete about 7 inches in diameter that requires very rapid operation for placing it and makes possible the placing of 700 to 800 cubic yards in one 8-hour shift in the massive footing slab. The anchorages for the aerial cables are made with specially constructed ballast boxes containing 2,200 cubic feet of broken stone and set in pits 3 or 4 feet deep.

All of the excavation and pile driving has been completed and about 20,000 yards of concrete has been placed in the footings. The maximum force employed by the general contractor and subcontractors has been about 400 men.

The outstanding features of the work have been the very thorough preliminary study and analysis, the installing of abundant standard equipment for construction operations, the liberal use of steam and electric power, the provision for different operations to be carried on simultaneously without conflict or interruption, the insurance of surplus of vital supplies sufficient to cover ordinary delays and irregularities, the development of a perfected organization and efficient personnel, and the systematic classification and simplified records of costs.

The Effect of Hydrated Lime and Other Powdered Admixtures in Concrete

A SECOND edition of the valuable Bulletin 8, "Effect of Hydrated Lime and Other Powdered Admixtures in Concrete," by Duff A. Abrams, of the Structural Materials Research Laboratory, Lewis Institute, Chicago, is off the press. The paper was originally published in the Proceedings of the American Society for Testing Materials in 1920. The tables and diagrams have been revised to include two- and five-year tests.

This investigation was confined to powdered admixtures which are essentially inert in the presence of water and portland cement, as contrasted with liquids or soluble maerials. Most of the tests were made with hydrated lime, but 17 other powders were also used. The effect was studied of admixtures up to 50 per cent of the volume of cement on the compressive and tensile strength, wear, bond, and workability of concrete made with sand and pebbles and crushed limestone aggregate of different sizes and gradings, in mixes ranging from 1:2 to 1:9, and a wide range in consistencies. Seven different investigations were made, including more than 20,000 tests at ages of 3 days to 5 years.

The principal conclusions are:

In general, the strength of concrete was reduced approximately in proportion to the quantity of admixture. Some exceptions are noted below.

In usual concrete mixtures, each 1 per cent of hydrated lime (in terms of *volume* of cement) reduced the compressive strength 0.5 per cent; in terms of the *weight* of cement the reduction was 1.2 per cent. The reduction in strength caused by *replacing* cement with an equal volume of hydrated lime was about 1¼ times that caused by adding lime. High calcium and high magnesian limes produced the same effect.

The addition of 1 per cent of the following powdered admixtures in terms of the *volume* of cement *reduced* the strength of 1:4 concrete at 28 days by the following percentages: clay brick, 0.08; clay, 0.22; whiting, 0.24; sand, 0.37; natural cement, 0.38; limestone, 0.39; lava, 0.40; fluorspar, 0.43; kaolin, 0.47; kieselguhr (celite), 0.48; tufa, 0.51; hydrated lime, 0.56; ironite, 0.60; yellow ochre, 0.68; mica, 1.10; pitch, 1.50; gypsum, 4.00. For the same conditions the addition of 1 per cent portland cement *increased* the strength of concrete about 1 per cent; granulated slag showed an increase of 0.12 per cent.

Rich concrete mixes showed a greater loss in strength due to powdered admixtures than the leaner ones. In lean mixes (1:9 to 1:6) and those in which aggregates were graded too coarse for the quantity of cement used, the strength was little affected or was slightly increased by admix-

tures up to 50 per cent. The wetter mixes showed a greater loss in strength than the dry, due to the hydrated lime. The effect of admixtures was in general independent of the age of the concrete.

Hydrated lime and other powdered admixtures slightly increased the workability of the leaner mixes (1:9 and 1:6) as measured by the slump and flow tests. Ordinary mixes (1:5 and 1:4) were little affected; richer mixes (1:3 and 1:2) were made less workable. Lime and portland cement (up to 33 per cent) produced essentially the same effect on the "flow" of concrete.

The wear of concrete was not sensibly increased by hydrated lime or other powdered admixtures up to 20 per cent of the volume of cement.

The bond resistance was affected in the same manner as the compressive strength by the addition of hydrated lime.

For usual concrete mixtures a reduction in strength of about 10 per cent was produced by the use of hydrated lime in the percentages recommended by advocates of this practice of increasing the workability of concrete.

A Spectacular Building Accident

Failure of Guy-Wire Causes Accident with Few Casualties

THAT only six workmen were injured is truly remarkable when one considers the circumstances of the accident that occurred the middle of June on the 1 Park Avenue Building, at Fourth Avenue and 32nd Street, New York City. A guy-wire on a wooden derrick at the southwest corner of the building gave way, permitting the unstepping of the derrick boom. This occurred just as eight steel beams, each weighing about a ton, had been raised to the fourteenth floor. The unseating of the boom caused two of the beams, each 18 feet long, to shoot outward from the tenth story, where they struck a girder and fell, one inside the sidewalk line and one in the street. The remaining girders and the boom crashed down through the temporary wooden flooring and through four concrete floors to the basement, as shown in the accompanying illustration.

Many heavy boards and much loose material were carried down by the beams and the boom, causing a great cloud of dust and a terrifying roar which could be seen and heard for many blocks. Only six workmen were injured and none killed. In accordance with the usual custom, the uninjured workmen quit work for the rest of the day.

The Hay Foundry & Iron Works are the subcontractors for the steel framework, G. Richard Davis & Company being the general contractors.

Herald-Tribune Staff Photo

BOOM OF DERRICK WHICH CRASHED THROUGH FOUR FLOORS OF CONCRETE AND IMBEDDED ITSELF SEVERAL FEET IN THE EARTH IN THE BASEMENT

SPECIAL FEATURES IN SEPTEMBER ISSUE

The $50,000,000 building job of the Western Electric Company, at Kearny, N. J., heads the features in the September issue of CONTRACTORS' & ENGINEERS' MONTHLY. Other notable contributions are "Notes on the Construction of a Concrete Stadium," by Professor W. K. Hatt; a pictorial story of sewer construction in St. Louis; the construction of the 1½-billion-gallon reservoir at Tulsa, Okla.; and a highly instructive and entertaining article, "Service on Contractors' Equipment."

The Construction and Maintenance of Cement-Concrete Pavements

By Leon Belknap
Engineer-Manager, Oakland County Road Commission, Michigan

THE methods involved in the construction and maintenance of cement-concrete pavements are primarily a contractor's problem. His success financially depends upon the time spent in analyzing every item of the proposed work, and upon the skill by which he assembles the units of his organization into a smooth-working whole. Such problems as the source of materials, transportation, plant layout, water-supply, gradients, soils, handling of materials, local labor supply and wages, time limit of contract, equipment, capital investment, etc., must be carefully considered to insure success. He estimates the cost of building a proposed highway after having carefully considered each item and adds a reasonable profit for doing the work. Contractors who bid on highway work and use for a basis of their bids what other road work sold for, are in a measure guessing instead of analyzing all the features connected with the new work. He, however, should build in such a manner that a demand for his services is created. His reputation for skill, reliability, and integrity will not be judged entirely by how much profit he received from his work, but by how well the work was performed.

Contracting is perhaps more highly competitive than the manufacturing business, and the manufacturer of road-building equipment must remember that the ultimate test of his equipment is its final cost. That the manufacturers are keeping pace with progress in road building was evidenced at a recent machinery exhibition. Refinements of construction to insure long life, dependability, and economical operation were apparent. Heavy-duty units with enclosed bearings, force-feed oiling systems, and ease of inspection and repair of vital parts, were very noticeable. Tractor equipment with increased horse-power for heavy-duty machines in order to make this class of equipment more mobile for highway purposes, as well as lighter equipment designed for tractor operation, and a preponderance of gasoline-driven machinery over steam were very evident, showing a tendency to supplant methods in use heretofore. Improved machinery has a large part to play in successful road-building operations.

To say that one particular method is more successful than another in the construction of cement-concrete pavement, is rather a broad assertion. Each concrete road job is an individual problem by itself and should be so analyzed. Methods that work to good advantage on one job may be entirely inadequate on another. It is not the purpose of this paper to divulge any so-called "best methods" in the construction of cement-concrete roads, but to canvass to some extent the various methods in use.

Development of Cement-Concrete Pavement Construction

There has been considerable development in the past few years in the methods of constructing and maintaining cement-concrete pavements. This has been due to a process of evolution in several directions: First, there is an ever increasing demand for this type of road surface, as manifested by the mileage built each year. Second, the cost of construction and maintenance of highways is a problem in which the public are vitally interested. Third, a decided improvement in the design and construction of road-building equipment. Fourth, the design of cement-concrete pavements has been undergoing changes in an attempt not only to build a more balanced structure but also to provide more economy in its construction. Fifth, specifications have become more rigid in some respects, and the results show a decided improvement. As improved methods are obtained in the handling of materials, good pavements can be built cheaper, and more mileage is the result.

Subgrade

The building of a proper subgrade for hard-surface pavements requires considerable care in the manipulation of the earthwork. In general, the earth grade is first brought to a flat section with ditches roughed out and the width of grade possibly 6 inches wider than the finished section. The flat subgrade is then channeled to the required depth and the fine grading completed. If the plans call for a layer of granular or porous material to be placed on the subgrade where a clay soil exists, then the provisions must be made in the grading to allow for the addition of this material so as to conform to the subgrade elevation. Some contractors seem to grade only for the pavement section, and finish the shoulders and ditches after the pavement is completed. This latter method requires considerable end movements of earth and does not permit of the proper balancing of earthwork at the time of grading.

Slips and fresnoes are still useful equipment for short hauls up to approximately 300 feet. Hauls up to 700 feet are usually best accomplished by use of wheeled scrapers, and longer hauls by wagons or trucks, loaded by means of an elevating grader pulled by a tractor, or loaded by steam shovels. The steam shovel is in more common use in Michigan, and with trucks or teams and wagons overlaps the wheeler hauls, especially when large quantities of earthwork are involved. Gasoline tractors are used for hauling straight-

A TYPICAL SCENE ON A ROAD JOB OF A WELL-EQUIPPED CONTRACTOR

A Burton gasoline locomotive is shown hauling a train of Lakewood batch-boxes supplying the Koehring paver. A Lakewood finisher is shown in the foreground with the subgrader and motor road roller, and extra forms in the background

blade graders, scarifying, rooting, plowing, and for the loading and hauling of four-wheeled scrapers, and otherwise displace teams for this work to some extent.

Special care should be taken to prepare the subgrade in such a manner as to provide as uniform a support for the pavement as possible. All springy spots should be properly drained and refilled with dry material. The hard surfaces of old roads should be plowed to a depth of 6 inches and then compacted.

Machinery has, to a large extent, supplanted the pick and shovel gangs in fine grading. Although there is still need for hand labor for final cleaning up, the heavy part of the work can be accomplished by machinery. Gasoline tractors of the crawler type attached to a heavy blade grader and scarifier will remove the bulk of the earth in the channel. After the forms are set, a subgrade machine riding on the forms will cut the exact crown of the road-bed. A gasoline roller pulls the subgrade machine and compacts the subgrade at the same time. The subgrade is finally checked by a template. Nails, driven in the bottom edge of the template to the crown of the subgrade, as the template moves along the side forms indicate by scratches the high spots.

Construction

Forms.—The use of wooden side forms was permitted a few years ago, but since smoother pavements and better alignments are required, this type of form has been eliminated. The use of subgraders and heavy finishing machines has required more rigid forms with proper foundation support. In some soils it may become necessary to increase the bearing support of the forms by the addition of short pieces of lumber. Heavy equipment may cause the forms to sink and thereby reduce the thickness of the pavement appreciably as well as producing a wavy surface. Too much care cannot be taken in this regard if smooth pavements are to be obtained. A rough surface, often blamed on uneven aggregate and improper mixing, may be traceable to a lack of proper forms and the alignment and bearing for them. The new pavement section with thickened edge has required the use of side forms 9 inches deep.

Proportioning of Materials.—The supply of raw material, sand, gravel or crushed stone, and cement, is usually brought by rail from some distant point. The problem of unloading cars and proportioning materials is interwoven with the mixing operations. The latter consist of several methods: first, a central proportioning plant; second, a central mixing plant or a modification of it; and, third, the wheelbarrow method. The wheelbarrow method of proportioning aggregates was used almost entirely a few years ago. The measuring of materials was done by gaging the load on the wheelbarrows and then dumping into the skip of the mixer. The number of loads of each aggregate were counted to get the correct amount in each batch. Later, batch-boxes were used on belt conveyors, which carried the material to the mixer. This method has been largely discontinued because of the increased cost of labor and loss of material on the subgrade, as well as because of objections to dirty aggregate, which was occasionally delivered to the mixer. Proportioning of material at a central plant is a later development. Coarse and fine aggregate are unloaded from the cars by means of a clam with ¾- to 1-yard buckets and loaded into elevated bins. These bins are provided with measuring boxes so that proper proportions can be delivered to the hauling equipment. Where drop-bottom railroad cars are obtained, a bucket elevator is sometimes used to good advantage. Occasionally, contractors devise other means of unloading cars and loading trucks or batch-boxes. "Set-ups" have been observed where material from drop-bottom cars was unloaded into bins built under railroad trestles. Tunnels are frequently used which provide easy access for trucks or industrial cars under stock piles. Measuring boxes are provided in each case. Cement is shipped in sacks and requires separate storage at a convenient point where it can be readily placed on the trucks or in batch-boxes. Bulk cement might be handled to a greater advantage with a central mixing plant or proportioned by weight and deposited in separate compartments of batch-boxes. It has been discovered that the volume of sand is affected by the moisture content, and in

some cases compensation is made on account of this by altering the capacity of the measuring box. A central mixing plant simply consists of a rearrangement of the proportioning plant so as to discharge into a mixer, the wet batch being hauled onto the road. Modifications of this layout according to the contractors' idea of arrangement have been made. Stock piles have been placed at various intervals along the highway, and the mixer moved from stock pile to stock pile with the wet batches, then hauled to the road.

Transportation of Materials.—There are in general two methods of hauling materials to the mixer located on the subgrade: first, hauls made by a truck over the subgrade; second, hauls made by industrial equipment, or a combination of both methods. The adaptability of the foregoing methods seems to vary with the whim of the contractor where either method might apply. Industrial haulage by means of gasoline locomotives, cars, and light narrow-gage track is confined to minimum grades, and the amount of material that can be hauled by each train is limited by the maximum grade over which it is hauled. Batch-boxes, two in number for each car, are loaded at the proportioning plant and hauled to the mixer, and have either bottom or side dumps or are tilted when unloaded. The tracks are usually placed on the shoulder of the road with convenient switches, and at least one switch is placed near the mixer so as to delay mixing operations as little as possible. If the mixer works away from the source of supply, advantage may be taken of the finished portion of the pavement by placing the track on the pavement.

Trucks hauling materials to the mixer are in quite common use. These vary from the heavy 5-ton truck to the light truck with pneumatic tires. Heavy trucks are used more frequently in hauling material to a central stock pile rather than to a mixer, because of damage to the subgrade, which may require additional fine grading. In general, trucks can be used on steeper grades than industrial equipment and, where soil conditions permit, are more mobile and can take advantage of side roads where it would not pay to be continually changing industrial tracks. Frequently, heavy trucks are used to haul materials from a proportioning plant over a road where railroad crossings, grades, or other conditions prohibit industrial tracks, and in this case, where combined with industrial equipment, flat-decked trucks are used to carry batch-boxes, which are in turn transferred from the truck to industrial cars by means of a derrick or other apparatus. Turntables are provided for turning trucks around on the grade and inside the forms. Planks are occasionally used near the mixer to protect the subgrade, and they require moving as the work progresses.

Mixer Operations.—Mixers are now being operated by gasoline engines quite universally, because of the availability of gasoline supply and the reliability of motors. The size of mixers varies somewhat, although the general type is of 21 cubic feet capacity of wet mix. The mixers are usually equipped with timing devices so that the required number of turns is obtained automatically. Crane devices operated by mixer engines are used to lift batch-boxes from industrial cars and to dump them into the skip. The crawler type of traction for mixers is coming more into use because of the greater ease of portability. Boom and buckets have replaced the spout delivery of mixed concrete. Reinforcing wire mesh or bars are held in position while placing concrete by means of steel forms or bar chairs. The use of longitudinal center joints has required the use of installing devices, which, in addition to pins, hold the joint vertically in place. Care must be used in depositing concrete, to load the center joint equally on both sides.

The method of installing transverse expansion joints varies somewhat in different localities. The use of a plank cut to crown of subgrade against which the joint material is placed, requires the refilling of space after the plank is withdrawn and results in getting the joint material out of line either vertically or transversely across the pavement. A better installing device consists of a steel plate with V notches cut in the bottom so that the fresh concrete supports the joint on either side and when the form is withdrawn does not alter the position of joint filler and requires a minimum of additional concrete.

Finishing of Concrete.—There are several types of finishing machines on the market which make it possible to finish concrete of a stiffer mix than was possible before. The machines are propelled by gasoline power and ride on the steel side forms. The automatic striking of concrete to the required crown, the tamping of concrete, and the belting of the surface for final finish, are possible in one operation, although several trips of the finishing machine are generally required to produce a good surface. Hand belting methods have not been entirely discarded, as a good many localities use this method in addition to the finishing machine operations. Hand floats for finishing joints as well as other concrete surfaces are in use also. There is on the market a hand belting machine which is propelled by one man and gives the final belting of the concrete. This machine rides on the forms, similar to the finishing machine. Longitudinal strikes or floats are used in some states to help in eliminating waves on the surface, and are operated by hand from portable bridges.

Concrete pavements are now being checked by 10-foot straight edges. Specifications require the surface to be not more than ¼ of an inch from a smooth surface. Hand tools for rounding the edges of the slab to ½-inch radius are required.

Curing.—One of the methods used in curing consists in covering the surface with burlap as soon as the pavement has hardened sufficiently so that the concrete will not be injured, and then keeping it wet until the following day. A machine has been developed that carries the rolled burlap on a circular steel drum and rolls the burlap off the drum and on the pavement, or vice versa. The second day, the road is covered with earth to a depth of at least 2 inches, or with straw to a depth of at least 3 inches, and kept wet for a period of 14 days.

A later development in the curing of concrete is by the use of calcium chloride. This material is manufactured in flakes or granular particles and is shipped in 100-pound sacks or 350-pound drums. It can be either spread on the pavement by hand with shovels and broomed or placed by a special spreader operated by one man. The quantity placed per square yard varies from 2 to 4 pounds. It is usually placed on the concrete from 12 to 24 hours after the pavement is laid. During the season of the year when the temperature of the

atmosphere is low, or around 40 degrees, the application of chloride should be delayed for a time, depending upon the speed of the setting of the concrete, possibly for 36 hours. The calcium chloride method eliminates the labor of covering and uncovering the pavement with earth, and the quantity of water and labor necessary to sprinkle the pavement for a period of 14 days.

Contractors are required to bush-hammer or otherwise remove high spots in the concrete, which exceed ¼-inch when tested with a 10-foot straight edge. There have been several attempts at devising some mechanical means of performing this work. Stone chisels operated by an air-compressor to remove the excess surface and then rubbing down with a brick does not provide anything but a slow, tedious job. An enterprising contractor has designed an ingenious device in which he used a Fordson tractor with an attachment supporting a vertical shaft at the lower end of which is a circular carborundum stone. This stone is caused to rotate by means of a belt from the tractor, and the grinder is easily moved around over the surface to be reduced.

FINISHING MACHINE IN ACTION, SHOWING LABORER REMOVING EXCESS CONCRETE

Maintenance

Cement-concrete pavements, like other highway surfaces, have not as yet reached such a stage of perfection that maintenance may be entirely eliminated. It is safe to say that a well-designed and well-constructed pavement of this type requires as little maintenance as any other type of road surface. The other types of cement-concrete pavement, which were laid either of a thickness inadequate for present-day traffic or without the advantage of research in the matter of design, require an amount of maintenance in excess of that found necessary in a well-built pavement. Frost action, poor drainage, improperly constructed subgrade, and lack of maintenance at the proper time, are some of the causes of failure in pavement slabs. The inclined position of joint material has caused one slab to climb higher than the adjacent slab because of expansion, in which position impact from heavily-loaded vehicles causes the gradual destruction of the section and discloses the carelessness in construction. The placing of pavement on newly graded roads, especially where heavy cuts and fills are made and proper settlement of earth has not taken place, has also tended to increase the cost of maintenance. Where the minimum width of pavement has been increased from 16 to 20 feet, there has been a decided reduction in the number of failures due to corner breaks and progressive failure of slabs. The increased width has permitted heavy trucks to travel at a greater distance from the edge of the pavement slab and therefore makes damage less liable. Smoother surfaces have reduced the impact from heavy truck loads and brought about a greater use of pneumatic tire equipment for the intermediate size of trucks. Increased motor vehicle travel near our large industrial centers has required the widening of some of the main arteries; yet there are and will be, for some time to come, many pavements 16 and 18 feet in width, which are carrying an excessive amount of travel and should be widened at this time. These pavements demand considerable maintenance and may fail faster than like pavements in less congested centers. In comparing the cost of maintenance of various types of pavement, the amount and character of the traffic should be considered as well as other conditions surrounding the construction of the pavement.

The maintenance of cement-concrete pavement as different from gravel or other types of road surface, has developed a "gang system" of repair similar to that of section hands on the railroad. These gangs are equipped with light pneumatic-tired trucks for ease in moving from place to place on highways. Their job is to patrol the pavement, giving whatever attention is necessary at the proper time. Aside from the work required to keep weeds cut and shoulders properly repaired, the principal work necessary is to tar all cracks and joints so as to eliminate spalling and protect the subgrade from any undue moisture and the patching of broken places in the slab.

Patching Concrete.—The broken section of the pavement must be removed and the edges of the adjoining slabs squared up so as to permit of a

good bond. A little care in removing the old concrete so that few radial cracks remain is quite essential. If the patch is cut in such a manner as to give a reasonable area for the transmitting of the load to the subgrade as well as eliminating all acute angles where bonded to the old pavement, the patch will remain a part of the pavement. The excavation for the patch should be at least an inch deeper than the original slab. An air-compressor mounted on truck or trailer and of sufficient capacity to operate at least two concrete breakers for reducing the broken edges of the old slab and trimming up the adjoining edges, saves considerable time and labor over the old hand method of using chisels. Where a considerable amount of concrete is to be broken out, some form of drop hammer mounted on a truck may work to better advantage. The old concrete can be broken up and removed in a few hours in sufficient quantity to keep a gang patching all day. Side forms should be placed and securely staked to a depth at least equal to the old pavement. Material—sand, gravel and cement—is deposited by means of trucks on one side of the pavement near the slab. A portable mixer of 7 cubic feet capacity, with roller bearings and rubber tires, usually works to a good advantage in the ordinary patching work. It does not take up very much space on the highway and is easily moved from patch to patch by a small truck.

The aggregate is wheeled to the mixer in wheelbarrows. Water is supplied in barrels or tank wagons filled at some convenient point. A central mixing plant, if convenient to the work, is sometimes used so as not to obstruct traffic, as it is necessary on most concrete roads to patch only one side of the pavement at a time and to leave some distance between patches so as to facilitate the movement of traffic. The patch should be struck off and finished to a smooth surface with the adjoining slab, as consistent with good practice in original construction.

Calcium chloride dissolved in the mixing water is quite desirable in the patching of pavement. Two to four per cent of this material by weight is found to be the correct proportion, the variation in amount depending on the temperature of the atmosphere. Patches which heretofore were kept closed for twenty-one days can be opened within a week without damage to the concrete. This represents quite a saving in watchman service, broken lanterns, and barricades. The recent development of aluminate cement in this country may further reduce the cost to traffic in delay and accident hazards where used in patching, as this cement sets within twenty-four hours.

Tarring Cracks and Joints.—A small portable tar kettle of a capacity sufficient to hold at least two barrels of tar, with hand pouring pots, brooms, and sufficient sand to cover the fresh tar, are some of the requisites of this part of the work. Barrels of tar, as well as small piles of sand, may be distributed along the highway. A good combination for tarring cracks consists of a truck, loaded with sand, which pulls a tar kettle slowly along as the work progresses. One man sweeps out all the dirt from the cracks, while a second man pours the joint, and the third man covers the fresh tar with sand so that it does not pick up with wheel traffic.

A later development in the method of handling tar consists of a stationary tank sufficient to hold 15 to 20 thousand gallons in a central yard where tar may be handled in tank-car lots by means of a pump and steam heat. The tar can be preheated before the gang starts out on the road, so as to avoid delay in commencing operations. A portable tank sufficient to hold the day's requirements may then be carried on the truck or trailer. There is considerable saving in the cost of tar and in time lost in the handling of tar in barrels, by this method. Asphalt may be used with success instead of tar for the pouring of cracks and joints, although the writer has had very little experience with this material. There would be very little difference in the methods of handling them.

Conclusion

It has been shown that the construction and maintenance of cement-concrete pavement has resulted in an increased use of motor traction and power equipment. This has been due in a great measure to the manufacturer, who has made wonderful progress in the designing and construction of machinery to supplant man-power, and to the perfection of that machinery so as to insure long life, dependability, and economical operation. The contractors in turn have perfected organizations the nuclei of which at least are carried on the pay-roll the year around, so that production can be carried out with a minimum of direction.

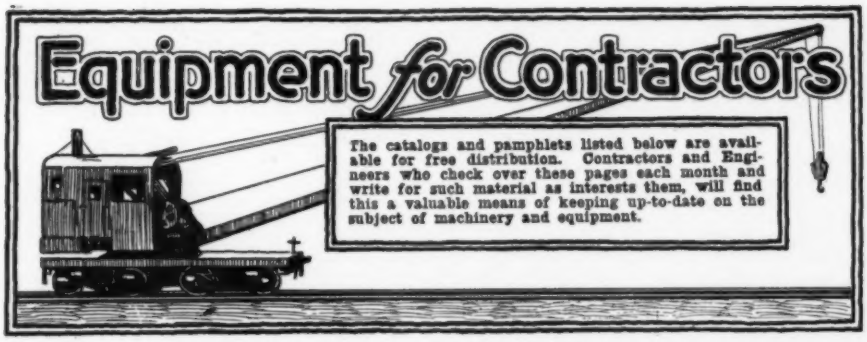
The necessary skilled labor for work of this character is more plentiful on account of an increasing amount of road work being carried on and new hands learning the trade. The successful contractor takes better care of his equipment, maintains yards and repair shops so that first-class equipment furnishes better work at less cost and delay, and makes workable methods that reduce hand power and team power to a minimum and otherwise guarantee a satisfactory season's performance.

ACKNOWLEDGMENT.—A paper presented at the Eleventh Annual Conference on Highway Engineering, at the University of Michigan.

Accidents Decreasing in the Construction Field

THE latest tabulations compiled by members of the National Safety Council in the construction field show that the number of construction accidents is being reduced. The current report, just released, reveals an average severity rate of 4.603, which is much lower than the construction section showed in either 1923 or 1922. This indicates that the construction industry has done some excellent accident prevention work and shows that hazards in the industry can be eliminated, according to W. D. Keefer, Director of the Industrial Safety Division of the National Safety Council. The latest tabulation is larger than ever before, as the result of the growth and interest in the section.

Two companies, each of them employing an average of over 400 men, finished the year without a lost-time accident. The number of deaths is the same in this year's tabulation as was the case in 1923, when only six general contractors gave their experiences. The number of permanent partial disabilities reported by the 23 members this year is much lower than that reported by the six members last year.



A NEW 20-HORSE-POWER GASOLINE HOIST

The new 20-horse-power Flory gasoline hoist with Fordson motor, which is recommended highly by builders and contractors, is described in literature which may be secured from the S. Flory Mfg. Co., Bangor, Pa.

WELL-BUILT TRACTION WHEELS FOR FORDSONS

There is nothing cheap about the construction of Grid-Iron-Grip wheels built by the Tractor Grip Wheel Co., 2246 Water Works Drive, Toledo, Ohio, and described in this company's literature.

A BOOK ON ROAD FORMS

The Heltzel Steel Form and Iron Co., Warren, Ohio, is distributing a free booklet, "Form Setting and Its Relation to the Riding Qualities of Concrete Pavements," by C. N. Connor, State Construction Engineer, Raleigh, N. C. This book is free and is a valuable help to any road-building contractor.

AN ACCURATE LEVEL FOR CONTRACTORS

Bulletin E-8 issued by the Warren-Knight Co., 136 N. 12th St., Philadelphia, Pa., describes the Sterling engineer's wye level, which is suited to the requirements of contracting service.

STEEL DUMP BODIES FOR LIGHT TRUCKS

Hughes-Keenan steel dump bodies that are built to withstand the hardest service under all conditions, for Graham, International, Ford, Reo, Federal-Knight, Mason, Chevrolet, and all other light trucks, are described in full in the literature of the Hughes-Keenan Co., Mansfield, Ohio.

THE COST OF UP-KEEP OF DUMP-WAGONS

Catalog W-62 issued by the Western Wheeled Scraper Co., Aurora, Ill., gives some interesting cost figures on the up-keep of Western dump-wagons, showing how they cost less than others in the long run, are easier on your teams, and better able to "stand grief."

A NEW ½-YARD FULL-REVOLVING EXCAVATOR

A description of the new P & H 204 ½-yard full-revolving excavator for gasoline or electric operation may be secured from the Harnischfeger Corp., Milwaukee, Wis. This machine handles a ½-yard dragline or clam-shell bucket on a 30-foot boom.

HONESTLY MADE SHOVELS

Ames shovels, spades, and scoops are honor goods. The Oliver Ames & Sons Corp., North Easton, Mass., of the Ames Shovel and Tool Co., Boston, Mass., will be pleased to supply a copy of its complete catalog to any contractor interested.

WIRE ROPE THAT IDENTIFIES ITSELF

Williamsport wire rope, according to its manufacturers, the Williamsport Wire Rope Co., Williamsport, Pa., is the only wire rope made that shows its exact grade so that any one may know and understand what it is. Interesting literature on this protection may be secured by any contractor.

AN EFFICIENT BACK-DUMP BUCKET

The Pioneer back-dump bucket, which is a great money-saver in dragline work, is described in the literature of the Pioneer Bucket Co., successors to the Mansfield Engineering Co., Fletcher Savings & Trust Bldg., Indianapolis, Ind.

CHUTE UNLOADS CARS QUICKLY

The Dow quick-unloading car chute, which hooks to the side of the gravel or stone car and is filled by hand labor, dumping instantly as soon as the truck is ready to receive the load, is described in a folder issued by the Dow Co., Inc., Louisville, Ky.

A SIDE-DUMP BODY FOR FORDS

The Herr side-dump body, which is quickly dumped by hand and which drops the load wherever desired, keeping the road clear, is described in an illustrated folder which may be secured from the Herr Dump Car Mfg. Co., Coatesville, Pa.

WHAT CONTRACTORS SAY ABOUT THE CENTER DRIVE FOR POWER SHOVELS

Thew Bulletin 201 tells what contractors think of the new Thew center-drive shovel mounting, based on their actual experience with this machine since last January. This bulletin may be secured without charge from the Thew Shovel Co., Lorain, Ohio.

A LOW-PRICE CRAWLING TRACTOR CRANE

Book 120 issued by Industrial Works, Bay City, Mich., describes the new Industrial crawling tractor cranes, which are said to be outstanding achievements at an astonishingly low price.

AN ECONOMICAL ADJUSTABLE SHORE

The Atlas shore, which weighs only 65 pounds and which is readily adjustable, holds its load without creeping, and is more economical than the use of 2x4 lumber in shoring, is described in full in well-illustrated circulars which may be secured from Charles A. Roos, President, Roos-Meyer-Hecht Co., 2824 Stanton Ave., Cincinnati, Ohio.

FORDSON LOADER WITH FEEDING MECHANISM

The Specialty-Fordson loader made by the Specialty Engineering Co., Allegheny and Trenton Aves., Philadelphia, Pa., is now equipped with a feeding mechanism consisting of a spiral screw which brings the material to the bucket, as well as with a crowding mechanism, both of which are described in full in literature which may be secured free on request.

PNEUMATIC SURFACING EQUIPMENT

The most recent Dallett catalog, No. 10, issued by The Dallett Co., Broad & Federal Sts., Philadelphia, Pa., is a veritable text-book on all types of pneumatic surfacing equipment and should be in the hands of every contractor having concrete surfacing work in prospect.

A PORTABLE WOODWORKER

The Jaeger portable woodworker, which can be mounted in one minute on the front of any Ford car and as quickly removed, is able to handle any kind of sawing on the average building job. It is described in full in a circular of the Detroit Nut Co., Inc., Hubbard Ave. & Michigan Central Ry., Detroit, Mich.

A SMALL PORTABLE ASPHALT PLANT

The Chausse Oil Burner Co., Elkhart, Ind., has placed on the market a small portable asphalt plant for patch work in repairing streets. This plant, described in the company's latest literature, is a complete unit capable of handling a full patching program at moderate cost.

AN EFFECTIVE DITCHER SCOOP

Bulletin No. 36 issued by the Orton & Steinbrenner Co., 608 S. Dearborn St., Chicago, Ill., describes this company's dependable truck crane and particularly its full-circle swing crane with ditcher scoop, a piece of equipment which has the advantages of the power shovel and the dragline.

A STRONGER DIPPER FRONT

The Clark bridge-type dipper front, which has a double wall supported by connecting rims which form sockets for teeth and in which 3, 4, 5, or 9 teeth can be used, depending on the kind of material to be dug, is described in literature which may be secured from the American Manganese Steel Co., Chicago Heights, Ill.

A NEW AND LARGER ROAD CATALOG

The 1925 General Catalog issued by the Austin-Western Road Machinery Co., 400 N. Michigan Blvd., Chicago, Ill., is larger and even more interesting than this company's former catalog. Of particular importance in this edition are the leaning-wheel graders, motor graders, portable conveyors, and 4-cylinder motor rollers.

A FIVE-BAG OR SIX-BAG CONCRETE MIXER

In an interesting booklet, "5 Bags or 6," the Foote Co., Inc., Nunda, N. Y., clearly outlines the case for the 26-E paver, capable of handling either a 5-bag or a 6-bag batch economically.

FORTY USES FOR A CRAWLER TRACTOR

Forty different uses for the Trackson Full-Crawler for the Fordson tractor, are described and illustrated in a new 12-page booklet just issued by the Full-Crawler Company, 500 Clinton St., Milwaukee, Wis. The Trackson is shown in combination with other equipment, such as the Wehr grader, Baker backfiller, Tomahawk snow-plow, etc., in the booklet, which will be sent free on request.

A BUCKET WITH ADVANTAGES OF DRAGLINE AND CLAM-SHELL

The new Dunbar Drag-Clam, which is the result of two decades of practical experience in the field of excavation and dredging, has many interesting features which increase its efficiency over the ordinary dragline bucket on all kinds of work in this field. This bucket is described in full in a folder which may be secured free by any interested contractor, from the Dunbar & Sullivan Dredging Co., 610 Erie County Bank Bldg., Buffalo, N. Y.

A TRACTOR BUILT FOR ROAD WORK

The Yuba Products Co., 433 California St., San Francisco, Calif., has issued a very interesting bulletin-catalog on the Yuba Rodebilder, a tractor with crawler tread, designed specifically for building roads and moving loads.

CREOSOTED PINE PRODUCTS

The illustrated catalog of the Southern Wood Preserving Co., Atlanta, Ga., completely describes the need of wood preservation, wood preserving processes, the Creo-pine full-cell process, and the Creo-pine empty-cell process, each of which has its advantages for specific products.

TRUCKS THAT PUT THE JOB THROUGH

High quality and dependability mark every United Constructor which is helping to put across the tremendous new road campaigns in the different states. These trucks are described fully in the literature of the United Motors Products Co., Grand Rapids, Mich.

BELT CONVEYORS FOR GRAVEL PLANTS

Catalog No. 102 issued by the Stearns Conveyor Co., Cleveland, Ohio, describes this company's belt conveyors for gravel, as well as its spiral conveyors, car movers and wall winches, all of which are of interest to contractors.

MORE THAN 400,000 IN SERVICE

There are more than 400,000 single, sturdy, powerful Hercules engines in service, running smoothly, and giving dependable and economical service with a minimum fuel consumption. This engine, with its Wico magneto for contracting service, is described in full in the literature of the Hercules Corp., Engine Div., Evansville, Ind.

A HEAVY ROLLER WITH SIDE SCARIFIER

The Buffalo-Springfield maintenance roller, built in sizes of from 12 to 17 tons with an oscillating scarifier on the left roll, making it possible to scarify when going both forward and backward, as well as close to the curb, is described in the literature of the Buffalo-Springfield Roller Co., Springfield, Ohio.

IMPROVED MODELS OF ASPHALT AND TOOL HEATERS

Littleford Bros., 485 E. Pearl St., Cincinnati, Ohio, have brought out two new models in their line of road contractors' equipment—the new No. 48 tar and asphalt heater, and the new No. 90 oil-burning tool heater. These and other equipment are described in the new 32-page catalog, which may be secured free on request.

DEVICES FOR FIRING ELECTRIC DETONATORS

The Electric Explosives Service Bulletin, issued by E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del., contains a great deal of helpful information, with figures and illustrations of devices for firing electric detonators in blasting operations.

LETTERING GUIDES FOR SLANT SYSTEM AVAILABLE

The Wood-Regan Instrument Co., Inc., 154 Nassau St., New York City, whose Wrico lettering guides have proved such time-savers and so effective in all kinds of engineering endeavor, has brought out guides for a slant lettering system which is described fully in Supplement No. 1 to the Wrico 1925 catalog.

FOUR SMALL TILTING MIXERS

The T. L. Smith Co., Milwaukee, Wis., has just issued a folder completely describing its new line of small tilting mixers in four models which should particularly interest contractors.

AN EXTRA-STRONG DUMP-TRUCK BODY

The Chicago-type excavating body with an unusually strong floor and sides has been developed by the Heil Co., 1243 - 26th Ave., Milwaukee, Wis., for excavating-contractors and is described in full in literature which may be secured free on request.

ONE-PIECE STEEL RIVET FORGES

Circulars describing the complete series of steel hearth forges made by the Buffalo Forge Co., 490 Broadway, Buffalo, N. Y., may be secured free by any contractor interested.

FIVE VALUABLE POWER SHOVEL BULLETINS

The Marion Steam Shovel Co., Marion, Ohio, will be pleased to mail any one or all of its power shovel bulletins to interested contractors: Bulletin No. 305, ¾-yard steam shovel; Bulletin No. 309, ¾-yard electric and gasoline-electric shovel; Bulletin No. 307, 1¼-cubic-yard steam shovel; Bulletin No. 310, 1¼-cubic-yard and 1¾-cubic-yard electric shovel; Bulletin No. 308, 1¾-cubic-yard steam shovel.

IMPACT ON PAVEMENTS AND WATERPROOFING

Bulletin No. 306 which may be secured from G. W. Hutchinson, the Celite Products Co., 11 Broadway, New York City, contains a very interesting paper based on a study of impact in its relation to pavement design, and also valuable information on waterproofing concrete.

A NEW LOW-PRESSURE ACETYLENE GENERATOR

A small generator for producing acetylene at low pressure for welding and cutting has recently been developed by the Oxweld Acetylene Co., 30 E. 42nd St., New York City, and is described in its latest literature.

A COMPLETE MIXING, HOISTING AND SPOUTING PLANT

The new concrete mixing, hoisting, and spouting plant developed by the Archer Iron Works, 34th Pl. and Western Ave., Chicago, Ill., is described completely in a folder which may be secured free on request.

CABLEWAYS FOR CONSTRUCTION WORK

The literature of the Lidgerwood Mfg. Co., 96 Liberty St., New York, describes many interesting installations of Lidgerwood cableways used in the erection of falsework, handling of forms, erection of reinforcing steel and concrete, and, in fact, practically all of the work in connection with bridge, dam, and many other types of construction.

ROTARY SCRAPERS SPEED GRADING

The superior service of the Reynolds rotary scraper, which works fast and is safe, simple, and easy to operate, is described in the catalog of the Killifer Mfg. Co., Box 270, Huntington Park, Los Angeles, Calif.

DOUBLE-ACTING PILE HAMMERS

A new Bulletin 35 has just been issued by the McKiernan-Terry Drill Co., 19 Park Row, New York City, describing its complete line of double-acting pile hammers for all pile-driving purposes, as well as submarine pile driving and pile pulling.

HOISTING CHAIN FOR POWER SHOVELS

A very interesting bulletin, S-20, on hoisting chain for power shovels, may be secured gratis from the Bucyrus Co., Specialty Dept., South Milwaukee, Wis.

AN IMPROVED HOIST ATTACHMENT FOR FORDSONS

The Clyde Iron Works Sales Co., Duluth, Minn., will be pleased to furnish information to contractors on the new style Clyde hoist attachment for Fordsons. The hoist frame is fastened to the tractor by eight of the bolts which connect the rear axle housing and the transmission housing and three bolts through holes in the draw-bar cap.

SECTIONAL CAST IRON CULVERT PIPE

Alpicul sectional-interlocking cast iron culvert pipe with a smooth bore inside, which conforms to the requirements for load-supporting capacity as specified by the U. S. Bureau of Public Roads, as well as various state highway departments, is described in full in a folder which may be secured from the Alabama Pipe Co., Culvert Pipe Dept., Anniston, Ala.

QUANTITIES OF MATERIALS FOR CONCRETE

This is the title of Bulletin 9 issued by the Structural Materials Research Laboratory, Lewis Institute, 1951 W. Madison St., Chicago, Ill., which contains tables of proportions and quantities of cement and fine and coarse aggregate for concrete of 2,000, 2,500, 3,000, 3,500, and 4,000 pounds per square inch at 28 days.

AN ACETYLENE LIGHT FOR NIGHT WORK

The Milburn acetylene light, which is particularly adapted for the use of contractors, is fully described and illustrated in catalog No. 199 issued by the Alexander Milburn Co., 1416-28 W. Baltimore St., Baltimore, Md.

TRUCKS WITH CONTINUED VALUE

GMC trucks with two-range transmission built oversize of soft steel with multiple-disc clutch, over-size bearings, and full-pressure engine lubrication, and built to be worth as much a year from now as to-day, are described in the GMC booklet, which may be secured from the General Motors Truck Co., Dept. 49, Pontiac, Mich.

Building the Bee Line Highway in Jefferson County, Alabama

An Outline of J. J. McCarthy's Contract on the Reconstruction and Relocation of a Federal Aid Highway Involving the Handling of 187,600 Cubic Yards of Material

IN Jefferson County, Ala., from Birmingham to Montgomery, there was an arterial highway so steep and crooked that it was finally decided to abandon the old road in many places and construct it in an entirely new location. The section of the proposed road from Cahaba River Bridge to the top of Shade Mountain in Jefferson County, a distance of 7 miles, is known as Federal Aid Project No. 147 of the new Bee Line Highway. The contract for this work was let to J. J. McCarthy and the Newell Construction Company, both of Birmingham, Ala. McCarthy is handling the excavation and grading, and the Newell Construction Company will do the surfacing.

For a distance of about 4,000 feet of this project, the new road follows the old road and then goes off to the left toward Montgomery. On the new highway the maximum grade will in no place be over 6 per cent, and the sharpest curves are not more than 8 degrees. Work was started on this project on September 10, 1924, and it is expected that the grading will be completed before summer.

THE GARDNER AIR-COMPRESSOR WITH FORDSON TRACTOR DRIVE FURNISHING AIR FOR WAUGH CLIPPER DRILLS IN THE SAND ROCK CUT FOR THE LOWER END OF THE JOB

Heavy Excavation

The J. J. McCarthy contract will involve the excavation of about 142,000 cubic yards of earth and 45,600 cubic yards of rock. Work has been

BUILDING A FILL FOR A BRIDGE APPROACH

A TYPICAL SECTION CLEARED OF TIMBER FOR GRADING

J. J. McCARTHY'S SHOVEL IN A SAND ROCK CUT

A Gardner air-compressor is shown to the right

J. J. McCARTHY'S 20-B IN OPERATION

This Bucyrus shovel is served by seven 1½-yard Watson wagons on a short haul. Notice the fill in the background

J. J. McCARTHY'S 20-B STARTING OPERATIONS AT LOWER END OF THE CONTRACT

Little Red Wagons are serving this shovel

W. T. TAYLOR'S 20-B LOADING 1½-YARD EAGLE WAGONS

THE SHOVEL CREWS

To the left: J. A. Trawick, fireman; and John Roberts, operator of W. T. Taylor's 20-B. The right-hand view reading from left to right: Fred Bradshaw, operator of J. J. McCarthy's Bucyrus; Homer Israel, fireman; Robert, son of Mr. McCarthy; and Homer Milstead, helper

W. T. TAYLOR'S SHOVEL COMING DOWN THE LINE, WIDENING THE CUT

under way for some time at the lower end of the project in a cut of 20,000 cubic yards, most of which is sand rock. This cut is being drilled with Waugh Clipper drills and shot with 20 per cent dynamite. Air for these drills is furnished by a Gardner compressor capable of delivering 90 cubic feet of air per minute, and driven by a Fordson tractor.

Excavation is also under way at the middle of the job, but the cuts are not so deep and it is necessary to shoot the shale.

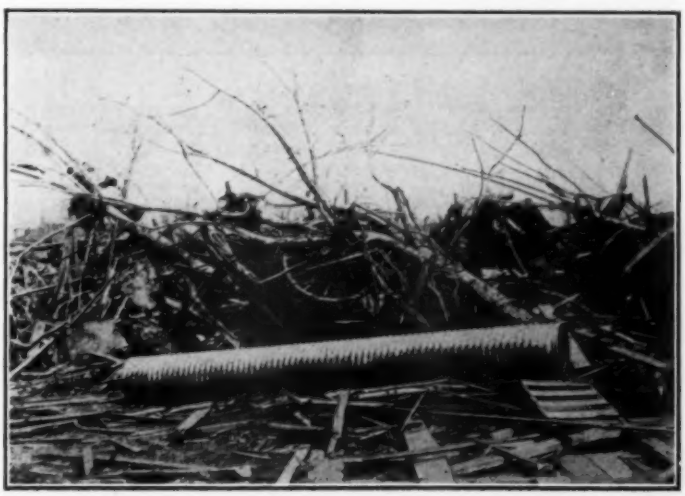
Three-Quarter-Yard Shovels Handling Excavation

J. J. McCarthy is using his Bucyrus 20-B shovel in the rock cut at the lower end of the job, and the machine in the middle of the job is also a 20-B Bucyrus, rented from the W. F. Taylor Construction Company of Birmingham, Ala. Both of these are standard 20-B steam shovels equipped with ¾-yard dippers and mounted on crawlers.

Seven 1¼-yard Watson wagons are serving the McCarthy machine on short hauls, and 1½-yard Eagle wagons are being used with the Taylor shovel. A 20-B team wheeler outfit is also being used on some of the lighter cuts.

On account of the exceptionally dry fall, it was necessary to haul water for both steam shovels, but coal is conveniently handled at near-by sidings. The water was hauled in 500-gallon tank wagons.

We are indebted to *The Excavating Engineer* for the information contained in this article, as well as for the illustrations.



TORNADO GAVE THIS CULVERT A HOLIDAY

The tornado which upset the Central States last March and moved so many trees, houses, tracks, and bridges, gave the Armco culvert shown here a holiday and carried it a long way from home. Contrary to the experience of the other items, it was uninjured by its frolic and was put back to work in the road where it came from

New Grader for Truck Patrol Use

Enclosed Gears and Rubber Tires Feature This Machine

TO meet the growing demand among highway officials and contractors for a stronger-built utility road grader which can be used with a motor truck in road work and then hauled a considerable distance to the next job without loss of time and without undue mechanical wear, the Stockland Road Machinery Company, Minneapolis, Minn., has produced the "Greyhound," a rubber-tired road grader. This machine was designed by L. B. Sherman of the Stockland Company's staff. A number of basic changes from the Special Patrol design of this company have been made. The chief one is in the steering mechanism, which is a combination of the built-in type and the pole device. The hitch has been lowered approximately 4 inches to eliminate pull-down when the hitch on the power is low, and also to counteract any tendency of the front truck to tip backward. The front tread has been reduced 6 inches to give additional clearance on the pole of the blade and to remove possible strain on the steering device.

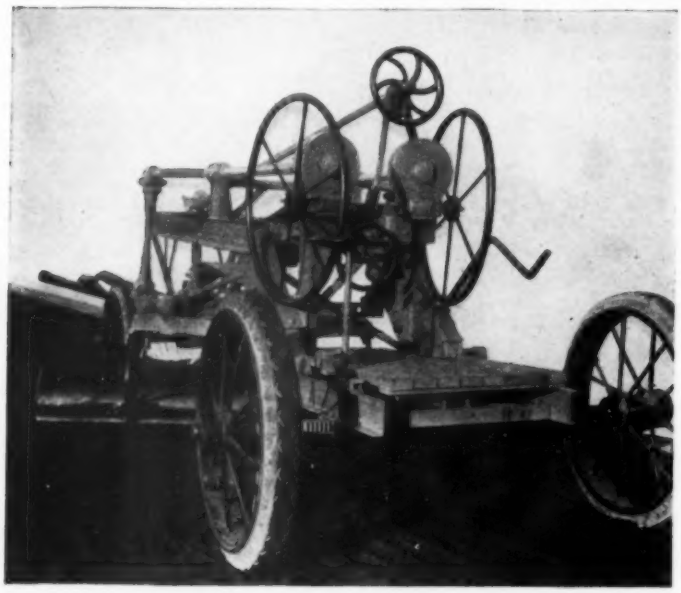
The entire front end of the grader is made heavier than standard construction to accommodate scarifier attachments and to hold them to the ground. The guide circles have increased length to give the circle additional support and bearing surface for wear. Another feature is the enclosing of all gears in dust-proof steel cases, which permit running the gears in oil or grease.

Aside from the bearings in the land wheel, all bearings are either of bronze or of babbitt and are protected with felt washers to help hold the grease and keep out the dust. Every permanent union is hot-riveted with over-size rivets, and all bolted joints are secured with close-fitting bolts drilled for cotter keys and fitted with castellated nuts to keep them from jarring loose from the vibration caused by the 18 to 20-mile per hour speed at which the grader may be hauled.

The frame is 4½ inches higher than the regular Special, which permits the blade to cut a 1 to 1 inside ditch slope. The wheel-base has also been increased from 12 feet 5 inches, which is the wheel-base of the Special, to 13 feet 3 inches, which will help in filling depressions and knocking off high spots in the roadway. The steering column has been raised so that the operator can stand on a box or get higher up in order to get a better view of his work and still handle the steering of the machine conveniently.

The lifting arms of the Greyhound grader are increased from 1¾ inches to 2 inches and are machined at the three bearing points. A new counter-shift rod is furnished, with tight joints, permitting free movement through any plane, and each joint is fully bushed and protected from dust and grit. The circle is also supported in the rear on swivel joints, and bushings and washers are furnished of the same type. The hand wheels on this machine have been narrowed down to a 29-inch spread, and a worm and gear axle shaft is furnished for the pivotal shift, which gives a shift at this point of 15 inches and is very fast and efficient. The gears on this shift are enclosed in a dust-proof case and are fully bushed.

The wheels are equipped with 40- x 5-inch solid tires at the rear of the machine, and 32- x 4-inch solid tires on the front of the machine. The bearings on the wheels are Hyatt heavy-duty bearings, and the operator's platform is suspended on coil springs to take any vibration of the machine off the operator's platform.



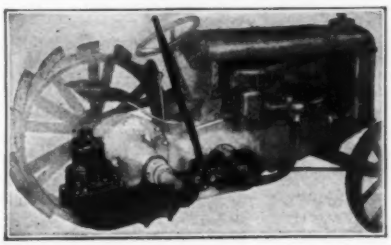
THE NEW STOCKLAND RUBBER-TIRED GRADER UNIT

An Improved Power Scraper for Dirt Moving

Three Years' Experience with the Original Machines Has Gone into New Unit.

CONTRACTORS face a great deal of work in the dirt-moving field, including grading roads and streets, excavating, stripping stone quarries, gravel-pits and coal mines, building parks and playgrounds, as well as dams and levees. The new improved power scraper which has been brought out by the Miami Trailer-Scraper Company, Troy, Ohio, has a number of features that are distinctly advantageous for these jobs.

The power winch for the operation of the scraper unit is attached to the housing and rear axle of the Fordson tractor. The main drive-shaft is equipped with three heavy-duty Timken taper roller bearings, and the two rear bearings are constantly lubricated by the oil in the gear case. The front bearing is lubricated by hard



POWER WINCH ATTACHED TO REAR AXLE OF FORDSON TRACTOR

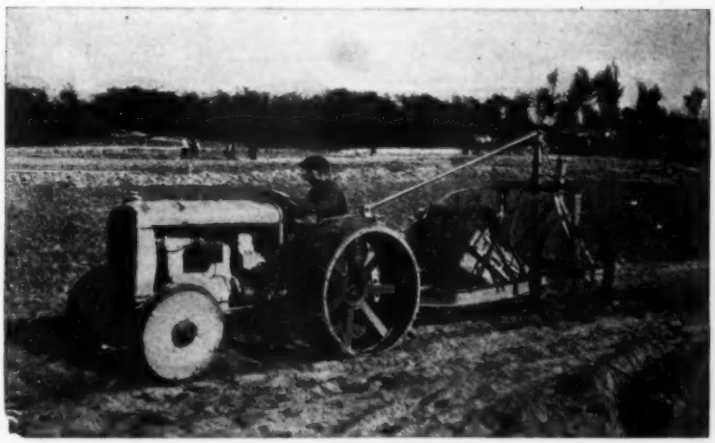
grease by means of large grease-cups. The bronze gear in the winch has been increased to 1¾ inches in diameter, which insures 100 per cent overload. The steel worm which drives the gear is hardened and ground. Both the worm and gear are enclosed in a dust-proof case and operated constantly in a bath of oil.

The frame of the original Miami-Fordson one-man power scraper has been increased from 5- to 6-inch channel steel, which makes a more rigid unit.

NEW EXTRA-STRONG HOOK WHICH REPLACES USUAL DRAW-BAR

One of the most important improvements is the cast steel automatic hitch. The ordinary plow hitch is entirely removed from the tractor, and a heavy hook is bolted on in its place. There are no holes to drill nor changes to make, and the same stud bolts are used. The scraper can be entirely disconnected from the Fordson in 30 seconds, leaving the tractor available for plowing or pulling trailers. The winch does not interfere in any way with other work, as it operates only when used in connection with the scraper. The cast steel hitch is also sold separately, as many contractors find it valuable for other classes of work.

The scraper pan of the Miami unit is made of high-carbon steel 3/16-inch thick. Each pan is punched so that a special cutting edge can be attached, if desired. This cutting edge can also be attached at the factory at a slight additional cost.



FORDSON OPERATOR RUNNING MIAMI SCRAPER

One man operates both the tractor and the scraper. The dirt is loaded, transported, and dumped without stopping and with the operator's leaving the driver's seat. It is a continuous one-man proposition, one unit replacing from three to five teams, depending on the length of the haul and the class of material to be handled.

The power scraper has been economically used for moving dirt up to 1,500 feet. The large pan is filled to capacity each trip. Because of the unusual construction, the dirt does not spill off while being transported, and the tractor can be operated at a high rate of speed, thereby saving a large amount of time and money.

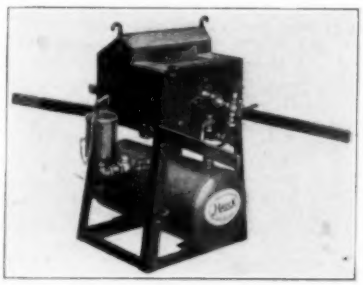
A Fuel-Oil-Burning Rivet Forge

An Outfit Which Gives Speed and Efficiency Where Riveting Is in Progress

A VENTURI fuel-oil-burning rivet forge of the suction type for use where riveting in steel and iron work constitutes a time- and labor-saving operation, has been developed by the Hauck Manufacturing Company, 126-134 Tenth Street, Brooklyn, N. Y. These rivet forges are built up of good material to insure long service under the severe operating conditions. The top, sides and bottom are of extra heavy steel plates, while the frame is made of heavy angle-irons. The furnace is lined with heat-resisting tile, asbestos insulation, and can be relined with standard fire-bricks. The forges comply with the safety and insurance requirements of the Associated Factory Mutual Fire Insurance Companies and bear their label of approval.

The Venturi type oil burner with which each forge is equipped insures safety to the men operating the forge because the fuel is sucked up by the burner using 30 pounds compressed air pressure or more. This eliminates any pressure on the oil-supply tank, which is unsealed, making it impossible to put any pressure on the oil; in fact, the tank can be filled while the forge is in operation. The burner lights instantly and produces an intense soft-soaking heat. The flame does not strike the rivets directly. It is stated that the flame will heat a ⅞-inch or a 1-inch rivet as thoroughly as the smaller sizes.

This forge is made in three sizes: the Midget forge, which has an over-all height of 29 inches, a width of 20 inches, and a depth of 25 inches, and which can be carried by hand or crane anywhere that is needed; the No. 507 forge, which has an over-all height of 44 inches and occupies a floor space of 28 x 42 inches; and the No. 504 forge, which has an over-all height of 46 inches and occupies a floor space of 36 x 54 inches. The latter two forges are mounted on wheels, so that they can be readily moved by one man.

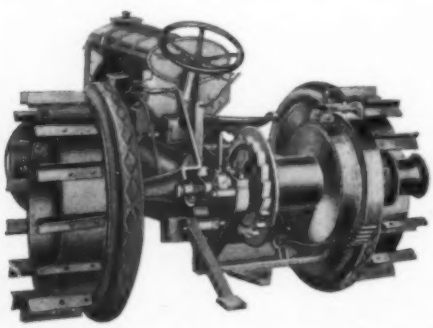


A HAUCK RIVET FORGE

The smallest size has an oil consumption of 1 gallon per hour and a heating capacity of 350 ¾ x 2-inch rivets per hour. The middle size has an oil consumption of 1½ gallons per hour and a normal heating capacity of 300 ¾- x 3-inch rivets per hour, and the largest size consumes 2 gallons of oil per hour and has a normal heating capacity of 400 ¾- x 3-inch rivets per hour.

Substantial Improvements in Hoist for Fordson Tractors

Hoist Frame Is Easily Secured to Tractor, and Power Applied Through Roller-Chain Drive



THE IMPROVED HOIST IN PLACEON FORDSON

A NEW style of hoist attachment for Fordson tractors has been placed on the market by the Clyde Iron Works Sales Company, Duluth, Minn. This hoist is of very sturdy construction and is attached in a manner that makes it as substantial as the tractor itself. The hoist frame is fastened to the Fordson tractor by eight of the bolts which connect the rear axle housing and the transmission housing, and three bolts through holes in the draw-bar cap. It is further held rigidly in place by guy rods which extend from the sides of the frame and are securely attached to the rear axle housing. The hoist frame is equipped with a draw-bar lug so that the tractor may be used for hauling purposes without removing the hoist or any part of it.

A winch head can be placed on any size of hoist that is large enough to permit its use for

auxiliary work. The hoist is so attached as to allow ample room between the winch head and the rear wheel of the tractor.

Power is applied through a roller-chain drive and sprockets from the pulley shaft of the Fordson. The pulley is removed and a sprocket installed in its place. A rod placed on the lever side of the hoist gives the operator full control of the throttle from his regular position. The drum is friction-driven and equipped with a ratchet and pawl, and an asbestos-lined brake band which is operated by a foot lever. This lever is placed in a position for convenient operation. The hand lever is made of forged steel.

The drum bushings are lubricated by grease-cups. All the shaft bearings are babbitted and also lubricated with grease-cups. The drum-shaft bearing is equipped with removable caps. This hoist is built in three sizes—No. 4001 with a line pull of 4,000 pounds at 175 feet per minute, No. 4002 with a line pull of 4,700 pounds at 150 feet per minute, and No. 4003 with a line pull of 5,600 pounds at 125 feet per minute. The drum barrel has a capacity of 600 feet of ½-inch cable.

Mountain Climbing a New Job for Power Shovels

A One-Yard Shovel Climbs 3,000 Feet for Stripping-Operations

A STORY has recently come to our attention which is vouched for by many witnesses and several photographs, one of which we reproduce. The George E. Lee Coal Company, Wilkes-Barre, Pa., wanted to strip the overlay from a coal seam 3,000 feet up on a mountain. The cost of special machinery seemed prohibitive, so they decided to use their Model-E Orton & Steinbrenner one-yard shovel. The cost of dismantling and of hauling the parts one mile up on a mountain road and reassembling, also seemed high, so they decided to drive the shovel up under its own power.

The road was hard, being cut largely through solid rock, but it was very crooked and quite narrow in places, so a survey was made and the trip started. From the accompanying photograph, it will be seen that the crawler-treads barely squeezed through in some places. The first thing to be done was to ford a creek at the bottom of the mountain, which was a good test of the running gear, and then the up-hill climb began. Some fear was expressed that the Climax Model-T gas engine could not make the grade, but this mechanical goat, emulating mountain-climbing goats which are common in the Alps, Rockies, and other places, kept right on climbing up grades as steep as 40 per cent in places, and reached the top without stalling once. The engine ran cool and showed plenty of reserve power at all times.

O & S ONE-YARD SHOVEL CLIMBING MOUNTAIN NEAR WILKES-BARRE, PA.

Recent Addition to Tilting-Drum Mixer Line

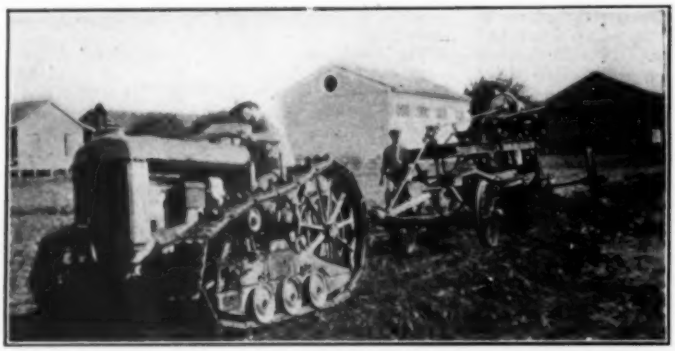
Outfit Designed for Jobs of Average Size

OF the recent additions to the mixers built by the Jaeger Machine Company, 701 Dublin Road, Columbus, Ohio, the new "Five" is one of the most interesting, as it is built particularly for handling the concrete work on jobs of average size, such as large sidewalk jobs, driveways, culverts, residences, churches, and the like. The mixing drum has the right capacity for a full-sack batch of 1:3:5 proportions and is the right size to economically handle this work.

This 5-L machine, illustrated, is complete with side loader, an accurate-measure tip-over water-tank and a gravity or balanced automatic device for turning the drum to loading and discharge positions. It is powered with a Hercules 3-horse-power, one-cylinder gasoline engine with new power-saving features in lifting the loader bucket. One man can handle every operation of the mixer from one position.

The frame and trucks are of approved design and of sturdy construction, built entirely of high-grade steel. The frame is mounted on steel or automobile wheels with demountable rims and cushion or pneumatic tires, making the outfit readily portable.

These Jaeger Fives are made in six different models to adapt them to every requirement of the small contractor.



BUILDING A ROAD ACROSS A CUBAN FIELD, USING A RUSSELL STANDARD GRADER WITH 6-FOOT BLADE DRAWN BY A TRACKSON-FORDSON

Tractor Versus Ox in Cuban Road Building

Trackson-Fordson Increases Road-Building Efficiency 600 Per Cent

SIX and eight head of oxen have always been thought necessary for hauling and building in Cuba. These oxen are unbelievedly slow and have a hauling capacity of but 3½ tons. Also, they are very expensive, costing $200 per head, with a heavy up-keep cost and much wasted time. According to Frank L. Jursik, the Cuban distributor, and E. E. Kuhn, a representative of the Trackson Full-Crawler Company, Milwaukee, Wis., Cubans are discarding the traditional ox for the Trackson-Fordson in road construction, thereby greatly increasing their road-building efficiency.

The Trackson traction has been found more important than speed, for many of the Cuban roads are wretchedly poor. The streets are seldom repaired and there are no real highways. During the six to eight months' rainy season the roadways are washed away quite rapidly. Holes one foot deep are common, and the two-wheeled ox-carts used for hauling sugar cane and logs cut ruts more than 8 inches deep in the roads, even in the driest months. Public sentiment is now calling for a central highway that will run across the island and be useful throughout the year, but the construction has not yet begun.

The era of the tractor has brought new road construction methods that will encourage street repair and maintenance, and the agitation for the central highway is the first tangible proof. The illustration reproduced above shows a Trackson-Fordson working on a job in Havana. A rooting plow was attached to the tractor, and an asphalt and rock road was plowed. At Florida, Cuba, a road was built across a field with a big 7-foot blade Russell grader attached to the tractor. The field was not only furrowed with ruts cut by the two-wheeled carts, but was studded with tree stumps, logs, and loose sugar cane. Building a road across such a field as this would have been impossible with a wheeled tractor, as the added traction given by the Trackson tread was necessary.

At Camaguey it was necessary to get a special permit from the Mayor to haul a big load of paving brick in an ordinary dump-wagon through the main city streets and through the mud-holes. This was the first time such permission had ever been granted, and it was given to the Full-Crawler operator because the Trackson has no permanent cleats. In this city also the tractor climbed 18 per cent hills hauling 1,000 feet of mahogany logs on a heavy 4-wheeled wagon. No grouters were used until a series of small hills were reached which were covered with small lava rocks, and the grouters were added to give the machine greater traction.

During this demonstrating trip, which was aimed to show that the Trackson full-crawler could increase the draw-bar power of the Fordson more than 30 per cent, Mr. Kuhn and Mr. Jursik met the line crew of the Phoenix Utility Company, which is now running a high-tension electric cable across and along the length of Cuba, and pulled three lengths of ½-inch diameter cable a mile long each across the field, stretching them over electric poles. This was at Ciego de Avila. The standard Fordson which the crew was using could not quite pull two lengths of cable a mile long across the rutty field.

Book Review

PROCEEDINGS OF THE TWENTY-FIRST ANNUAL CONVENTION, AMERICAN CONCRETE INSTITUTE, VOLUME XXI.

Published by the Institute, 1807 East Grand Boulevard, Detroit, Mich. 1925. 682 pp. Illustrated.

The Annual Proceedings of the American Concrete Institute, in addition to the list of officers and members, technical committees, and by-laws, contains a summary of the proceedings of the Twenty-First Annual Convention held in Chicago, Ill., February 24-27, 1925, and the entire set of very valuable papers presented at that time. The following are among the more important papers presented: Theory Must Aid Practice in Concrete Making; Concrete Mixtures Under Field Conditions; Notes on Laitance; Columns and Floor Forms—Examples of Framing and Releasing; Adjustable Shores Against 4 x 4 Shores; Notes on Construction of Concrete Stadium; Crazing in Cement Products; Proportioning Concrete Materials with Especial Reference to Highway Construction; Coefficient of Expansion Tests on Gunite; Central Mixing Plants for the Manufacture of Pre-mixed Concrete; Finishes in Stucco; Inundation as a Practical Aid to Uniform Concrete; Concrete Products Plant Operation; Manufacture of Light Concrete Building Tile; and Committee Reports.

New Attachment for a Power Shovel

Unique Crowding Device with Boom and Dipper Operated Through Live Drums Are Features

A ONE-HALF-YARD shovel which is unique in design and makes a valuable addition to the Bear-Cat shovel made by the Byers Machine Company, Ravenna, Ohio, has recently been announced. The Byers Bear-Cat is a gasoline-powered full-crawler unit operating excavating and handling attachments of ½-cubic-yard capacities. The machine itself is about three years old.

The latest of the attachments which have been developed is a half-yard shovel. The shovel is unique in that the crowding device is quite different from that usually found in gasoline shovels. The boom and dipper are both operated through live drums, the boom being raised and lowered to affect the crowd and to shake the dipper. In any shovel the effective crowding thrust can be only as great as the weight of the boom, regardless of the amount of power applied, because when sufficient power is applied at the shipper shaft of standard shovels to more than equal the weight of the boom applied at this point, the boom will simply be raised and no more thrust applied to the dipper. With this in mind, the dipper stick on the Bear Cat is hinged to the boom directly and the design so carried out that the operator has absolute control of the boom, providing the maximum crowding effort in either direction and at the same time eliminating the shipper shaft mechanism and crowd drums which are usually found in this equipment. This eliminates wear at this point and reduces the cost of the additional mechanism.

The shovel has the same dumping clearance as ¾-yard machines, and digs a level floor when required, and the dipper may be shaken to dump sticky material very efficiently. A daily yardage of between 300 and 400 may be usually expected, according to the manufacturers, who also claim very low first cost and cost of operation for the entire machine.

A BYERS BEAR CAT WITH NEW HALF-YARD DIPPER

A Front-Crawler Light-Weight Model Gas-Drive Excavator

Machine Has Unusual Strength and Power Despite Comparative Light Weight

SEVERAL manufacturers have set out to definitely prove that a power shovel can have rugged strength, power, punch, and efficiency and at the same time be comparatively light and portable. Various types of Keystone shovels have been on the market for twelve years and have demonstrated that an effective excavator can be built light enough for country bridges and quick moving. The new Model-4 front-crawler Keystone excavator made by the Keystone Driller Company, Beaver Falls, Pa., weighs about 17 tons, which includes about 1 ton of ballast. The wheelbase is 15 feet 8 inches, giving a desirable distribution of weight and increased stability. A half-length crawler of approved design has been mounted under the boom fulcrum, where the greatest weight and stresses are centered. This results in giving the machine admirable traction. It will negotiate any truck-passable road in low speed and will go one or two miles per hour.

The present Keystone Model-4 is the latest of nine models, each of which embodies a distinctive step in advance of its predecessors. It is built with the half-circle swing idea because this type of construction offers certain advantages in rigidity of foundation frame and economy of operation which the manufacturer feels have to be sacrificed in a full-revolving excavator.

The outstanding Keystone ideas in earth excavation, namely, the skimmer bucket and pull-stroke ditcher, are embodied in this machine. The skimmer is a heavy, effective scoop of ⅝-yard capac-

ity, carried on six chilled rolls with a dropping bottom hinged at the two ends. Because of its 14-foot horizontal crowd, it works remarkably well on shallow repaving jobs, tearing up old concrete, macadam, paving blocks, etc., with ease. The pull-stroke ditcher also has a bottom hinged at the toothed end, the bottom swinging free when dumping. The bucket is self-cleaning, so that even the narrowest bucket, 14 inches wide, can be operated in gumbo and sticky clay. Eight sizes up to 54 inches are manufactured, all of them usable on the same machine with the same set of attachments. The 24-inch and 30-inch buckets are most commonly used for ditching and cellar digging.

The Keystone ditching machine always stands on solid ground when working and is adaptable where any width or depth up to 20 feet is required. It can handle cellar excavation from the street level and does not have to be hauled out of the pit at the completion of the job.

The new Model-4 is powered with a 54-horsepower, 4-cylinder gas engine. The machine will handle a ½-yard clam-shell if desired for unloading cars, with boom extension and attachments which are not expensive.

Side-Dump Truck Body Saves Time

No Backing and Maneuvering into Position—Roadway Is Always Left Clear

A SIDE-DUMPING truck body built specially for Ford trucks and mechanically operated with little effort, has been placed on the market by the Herr Dump Car Manufacturing Company, Coatesville, Pa. This side-dump body is designed so that it fits exactly on the sills of the chassis, giving an even distribution of body weight. This distribution, according to the manufacturers, is maintained during the dumping operation, which is accomplished without jar or strain on any part of the truck frame.

The body is a self-contained unit which is carried upon its own sub-frame, that fits exactly on the sills of the Ford chassis frame that carries it. The sub-frame is secured in position by U-bolts and clips without drilling any holes or mutilating the chassis frame in any way. The entire time of mounting need not consume over one hour, which means a considerable saving.

The body itself is of steel built of 10- and 12-gage blue annealed sheets hot-riveted and welded. Seams are eliminated as far as possible and, also, the rivets are countersunk, making a smooth bed that dumps clean every time. The capacity of the body is 1¼ cubic yards level.

HERR SIDE-DUMP TRUCK BODIES BEING HAULED BY A FORDSON TRACTOR

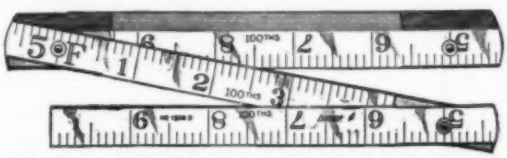
Contractors have evidenced unusual interest in this new dump body because of the saving in time and cost in handling hauling. A Washington contractor reports an extra profit or 10 per cent due to speeding up all down the line.

A New Folding Aluminum Rule

Graduations in Tenths and Hundredths of Feet of Advantage to Engineers, Surveyors, and Contractors

A FOLDING aluminum rule, graduated in tenths and hundredths of feet, is now offered by the Lufkin Rule Company, Saginaw, Mich., supplementing its line of aluminum rules with inch markings. The tenth-rule is designed to meet the needs of engineers, surveyors, contractors, highway builders, and others in related lines of work. As its opposite side bears the common graduation, feet, inches and sixteenths, the rule is suitable for all ordinary measuring. Graduations begin at the same end on both sides, so that a tenth measurement can readily be converted into terms of inches and vice versa.

This new rule is made in 6-foot lengths with 6-inch sections. It can be supplied either with or without an end hook. The end hook is particularly valuable in making measurements out of arm's reach. It readily folds up and remains flush with the end of the rule when not needed. The zero point falls at the inside of the hook when open, and at the extreme end of the rule when the hook is closed.



FOLDING ALUMINUM RULE SHOWING MARKS IN FEET, TENTHS, AND HUNDREDTHS

Concrete Cribbing in Railroad Grade-Elimination Work

Advantages of Cribbing Over Solid Wall Construction

IN connection with improvements and grade-elimination work along the Pennslyvania Railroad system at Cleveland, O., which was effected by raising the tracks, it was found necessary to build one track 10 feet higher than the right of way at the Pennsylvania warehouse. This was done so that the first floor of the warehouse, which had already been completed, would be on the same elevation as the floor of cars which were to be loaded and unloaded. An interlocking flexible concrete cribbing of I-beam construction was used for this work. It was found that by the use of concrete cribbing, practically all of the vibration caused by running two of the largest Baldwin locomotives over the structure was absorbed. The cribbing consists essentially of two members, a face member or stretcher and an anchor member or header, the design being such that the header and stretcher "automatically" interlock and square away. No level, in order to get below the frost line. Curvature is not difficult to take care of with this type of cribbing, as by proper and careful adjustment of stretcher lengths any desired radius of curvature can be easily and accurately maintained. Temporary crib walls, which are often necessary in railroad terminals, may be laid and relaid as often as desired, without any waste or deterioration in the cribbing.

The stretchers in this system of cribbing are 6 and 12 feet in length, 8 inches high, and 7¼ inches wide. They are made in the form of an I-beam reinforced with 6¼-inch square twisted bars running the full length of each member. Tie wires are used to keep the steel accurately and positively positioned. The tie wires are placed on 12-inch centers and 7 inches from the end. To doubly insure the accurate positioning of the reinforcing steel, washers are placed at intervals of 2 feet

COMPLETE CONCRETE CRIBBING FILL AT PENNSYLVANIA WAREHOUSE

dowels are used and there is no mortaring whatsoever.

At one end of the job it was found necessary to clear a switch stand. Expensive special form work would have been required in a monolithic wall in order to make this clearance. The R. C. Products Company, 1048 Engineers Building, Cleveland, Ohio, was able to accomplish the same results with their concrete cribbing by building a notch of about one foot at practically no additional expense or trouble.

No special equipment is necessary for laying this type of wall. The units are handled by very few men, thus reducing the cost of erection to a low figure. The wall can be built one section at a time and the excavation for each section used as a backfill for that preceding. In the job mentioned above it was unnecessary to build the wall in this manner, so that it was built the entire length and the backfill hand-rammed in 8-inch layers in order to compact it around each member.

No massive foundation was required, the wall being started about 23 inches below the ground around each bar. The headers are of lengths varying from 3 to 12 feet. They are equipped at each end with automatic interlockers of reinforced concrete. These take the place of what was formerly designated as filler and pillow blocks, and are now poured in direct attachment to the header.

The automatic interlocker does away with dowels, which are sometimes used in cribbing. In laying the wall, the bin construction was used. The joints are alternately broken, so that they are evenly distributed over the entire walls. Headers are spaced on 3-foot centers. Similar construction is used in the rear of the wall.

The headers may be staggered, if desired, or be of bin construction. All members are carefully designed to withstand the loads and earth pressure to which they are subjected in retaining the earth fill, not overlooking the proper width of opening to permit drainage and still not permit dirt to pass through the opening in the face of the wall. This is a very important point and cannot be stressed too greatly. Earth should not pass until the slope exceeds the 1½ to 1.

Walls may be built of R. C. concrete cribbing to a height of 50 feet. Particular attention was given in designing both headers and stretchers to keep the weight of the unit within reasonable limits, so that the cost of handling could be kept at a minimum and so that a wall of any desired height could be erected by a small gang of common laborers without the need and help of special construction equipment.

The stretchers weigh 31 pounds per foot and the headers 35 pounds. No particular skill is necessary in erecting this type of cribbing, care being taken only to obtain the proper foundation and batter. Some of the walls which have been constructed of this material have had a batter of only one inch to the foot because of the necessity of conserving every bit of ground in the railroad terminals. The usual batter is 2 inches per foot, and for certain unusual walls of excessive height it has been found desirable to use a batter of 3 inches and to go back into the rear of the wall with three rows of 6-foot headers, which is possible only through this system of interlocking of headers and stretchers.

Building the Largest Rock-Fill Dam in the World

Notes on the Construction of the Dix River Dam

THE Kentucky Hydro-Electric Company, through L. E. Myers & Company of Chicago, is now building one of the highest rock-fill dams in the world, on the Dix River, a placid stream in Kentucky. The Dix River at the point of this development flows at the bottom of a deep gorge between almost perpendicular cliffs which are between 300 and 400 feet high. The dam, which is now under construction, will be 900 feet long at the crest, 720 feet wide at the base, and 270 feet high. A road 20 feet wide will cross the top.

The dam will require approximately 1,600,000 yards of rock fill. This rock is obtained by excavating the spillway of the dam a short distance from the west wall of the gorge. The water in the gorge will be backed up for a distance of 33 miles. Every important labor-saving device known in modern construction work is being used on this job to facilitate quick construction. It is estimated that close to a quarter of a million feet of Williamsport Wire Rope alone is being used on the job.

TYPICAL CONSTRUCTION SCENE AT THE DIX RIVER DAM

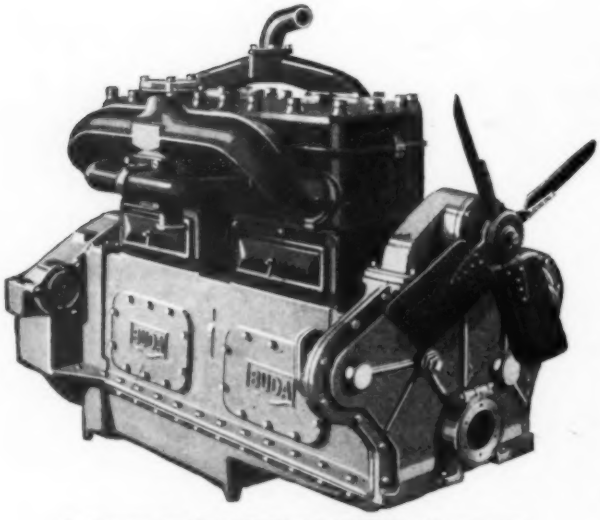
A New 4-Cylinder Industrial Engine

Unit Designed Specially for Operating Contracting Machinery

A NEW industrial engine known as Model JV has been brought out by the Buda Company, Harvey, Ill. This engine is of the 4-cylinder type, having a piston displacement of 749 cubic inches. It is intended for operating heavy industrial or contracting machinery where a heavy-duty engine is required. The engine develops approximately 50 brake horse-power at 600 r. p. m., and 83 brake horse-power at 1,000 r. p. m.

In the design of this engine many of the features of other models of Buda engines are used, although a few changes have been made to take care of conditions which prevail in the larger engines. The cylinder blocks are cast in pairs to facilitate handling, and the crank-case is made of gray iron and is of deep section, making the engine very rigid. The crank-case is equipped with large hand-hold plates on the carburetor side for inspection or adjustment purposes.

The intake and exhaust manifold design is the same as in smaller models of Buda engines, being of a special heated type, making it possible to use the lower grades of gasoline. Because of the highly developed manifolding of this engine, no hot-air stove is necessary, and dry gas enters the cylinders at a lower temperature than is encountered with other types of engines. This results in a higher volumetric efficiency, which means more power. The exhaust manifold has a vertical center outlet which makes a convenient connection for



THE NEW BUDA 4-CYLINDER INDUSTRIAL ENGINE

industrial purposes, as the exhaust may be carried off vertically from the center. The engine may be furnished either with a geared fan or with a belt-driven fan, and is laid out so that full power can be taken from the front end of the crank-shaft if an installation requires power to be taken from that end.

The oiling system is of the same kind of force-feed lubrication used in other models of Buda engines. The gear type of oil pump is driven from the cam-shaft and forces the oil through seamless steel tubing which is cast in the crank-case. Passages leading from this oil line to the main cam-shaft and rod bearings are drilled. The connecting rod bearings are forged with a rib in the center, through which is drilled an oil passage leading to the floating wrist-pin. Thus, all the working parts of the engine are under forced lubrication and there are no threaded oil connections in any part of the motor to leak or work loose.

One new feature of this engine is the oil-draining valve, the handle of which is brought up the side of the crank-case to a convenient location to the water pump. To drain the engine, it is not necessary to get underneath and remove the plug from the drain, as this is taken care of by turning the lever on the side of the crank-case. The lever is supplied with a snap lock so that there will be no chance of turning it accidentally. This engine is equipped with flange mounting for a two-unit electric generator and starter system. These mountings are made according to S.A.E. standards for a 12-volt system.

As this engine is designed primarily for industrial purposes such as cranes, hoists, air-compressors, shovels, pumps, and many other types of equipment, the fly-wheel is arranged to take a Twin Disc power take-off, which is recommended for this engine. Before the engine was designed, a very careful study of the operating conditions was made and the design made in accordance with these studies. The crank-shaft and bearings are exceptionally large, the shaft being 3 inches in diameter and the connecting rod bearings also 3 inches in diameter.

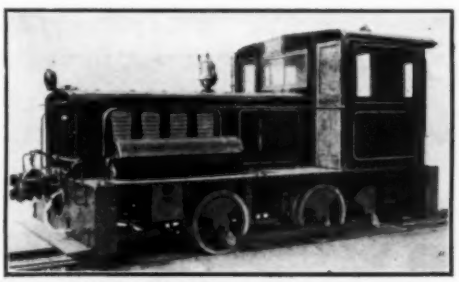
The engine may be purchased either in the bare condition shown in the illustration or with operating equipment, such as magneto, impulse starter, coupling, carburetor, governor, clutch power take-off, radiator, and sheet metal housing and steel base.

A New 20-Ton Gasoline Locomotive

Model HS-20 Built to Meet Demand for Heavier Units

THIS new 20-ton Vulcan gasoline locomotive has been designed and constructed very much along the same lines as the other models built by the Vulcan Iron Works, Wilkes-Barre, Pa. Steam locomotive practice is followed very closely in the chassis construction, the frame being of open-hearth cast steel, which affords long life and accessibility to all underneath parts. The springs are of the elliptic type with a cross-equalizing arrangement giving three-point suspension. On a standard-gage track in shifting railroad cars, for which this machine is primarily adapted, the locomotive is furnished with M. C. B. automatic couplers with spring buffer and draft rigging arrangement in the bumpers. This device takes up the shocks encountered in coupling and relieves the strain in pulling and pushing the heavy railroad cars, thereby protecting the motor and other working parts of the locomotive. The locomotive is mounted on four steel-tired driving wheels, and is powered with a 6-cylinder, 125-horse-power motor.

The motor is a heavy-duty industrial type with crank-shaft of drop-forged chrome nickel steel heat-treated and accurately machined as well as counterbalanced, thus permitting the engine to run at a moderately high speed without undue vibration.



DETAILS OF VULCAN 20-TON LOCOMOTIVE

TESTING VULCAN 20-TON GASOLINE LOCOMOTIVE BEFORE DELIVERY TO INTERNATIONAL MOTOR COMPANY

A built-in, well-lubricated, gear-driven governor is provided to guard the engine against overspeeding and racing. There is a centrifugal type water pump of ample size to provide proper cooling and also a forced-feed lubricating system.

The ignition system is of the dual type from a high-tension magneto with impulse coupling and a battery distribution with coil. Two spark-plugs per cylinder are used, the magneto being connected to the spark-plug over the intake valve, and the battery distributor to the spark-plug.

The motor is equipped with modern accessories such as electric starter and generator, Stromberg carburetor, and storage battery. The locomotive is provided with an oversize multiple-disc clutch running in a bath of oil, providing for an easy and smooth starting of the load with very light pressure on the foot pedal, thus making pedaling very comfortable.

The transmission is a trouble-proof transmission that insures efficiency by completely eliminating gear clashing and the difficulties that grow out of gear shifting. By using constant mesh gears, instead of the sliding type, speed changes are made more quickly and easily without loss of acceleration to the locomotive. The gear changes are made by the engagement of indestructible jaw clutches. Gears, clutches, and shafts are chrome nickel alloy steel forgings, properly heat-treated and hardened, thereby insuring long life with few replacements. The final drive is by means of driving and parallel rods from cranks on the jack-shaft to the crank-pins in the driving wheel, traction being thus provided on all wheels.

The air equipment is of the straight air and automatic brake type, complete with air-compressor, distributor valve, reservoirs, and all accessories. The air-compressor is driven from the power take-off on the transmission and is provided with an automatic governor throwing the air-compressor out of engagement when the pressure in the reservoir reaches a predetermined point.

The cab on the standard-gage locomotive is built very wide to enable the operator to take all train signals when handling wide box cars and other railroad rolling stock. All the controls inside the cab are conveniently located for the operator to manipulate without leaving his seat near the window on the right side of the cab. The locomotive is designed for four speeds forward and four speeds reverse, geared from 2 to 15 miles per hour with a maximum draw-bar pull of 12,000 pounds. It has a comparatively short wheel-base, making it easy to negotiate reasonably sharp curves.

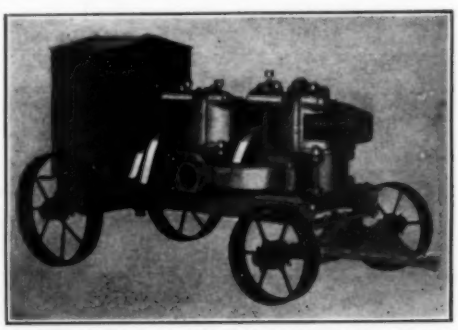
New Diaphragm Pump for Muddy or Gritty Water

Specially Designed with Skid or Truck Mounting for Use in Unwatering Footings, Trenches, Cellars, and Coffer-Dams

A NEW type of diaphragm trench or bilge pump which is mounted either on skids or trucks for the use of builders and general contractors in pumping water from footings, trenches, cellars, and coffer-dams, or on public works, has been developed by the C. H. & E. Manufacturing Company, Inc., Milwaukee, Wis. The difficulty which is experienced with many diaphragm pumps in the splashing of muddy waters is entirely eliminated in this pump, because the discharge end is long and leads the water away from all working parts.

This "Mud Hen" diaphragm pump has a water-hopper-cooled, 1½-horse-power gasoline engine with magneto and is capable of handling 6,000 gallons per hour with an extreme suction lift of 22 feet. The over-all length of the outfit is 38 inches, the width 33 inches, and the net weight of the outfit on a truck is only 700 pounds.

The truck frame consists of 4-inch channels with heavy iron plate ties, making a strong base. The entire speed reduction from the engine to the pump is made by one set of machine-cut, saw-tooth spur gears, and the operating eccentric is cast integral with the large gear. The pump diaphragm is operated by an overhead rocker-arm carried on two liberal bearings with grease cups.



SUCTION SIDE OF DOUBLE DIAPHRAGM PUMP

A New Line of Multiple-Cylinder Motors

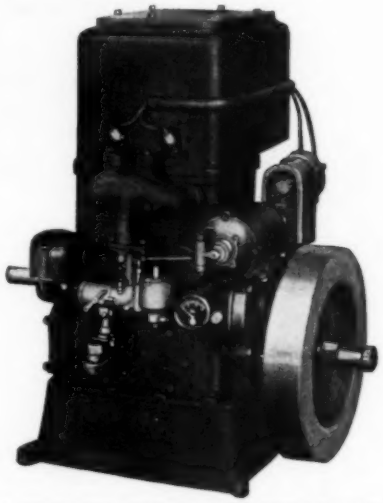
Well-known Manufacturers Extend Single-Cylinder Line

DESIRING that their new two-cylinder engines may fully live up to the reputation established by the single-cylinder model NB engine for continuous economical and dependable performance in the field, the Fuller & Johnson Manufacturing Company, Madison, Wis., has spent several years in the development of this unit, testing it for long periods before placing it on the market.

This engine is designed especially for industrial work and may be operated in either direction of rotation. It is built either for taking power from the crank-shaft or from a separate low-speed shaft with gear reductions approximately 2 to 1, which is standard, also 2½ to 1, and 3 to 1. This separate back-geared power shaft makes it possible to have ample-size shafts and bearings and to supply different gear ratios to suit the user's requirements. A double row of ball bearings carries the power end of the low-speed shaft.

The manufacturers state that the design is rigid, the weight moderate, and the engine easy to start and particularly well balanced, eliminating vibration. It is rated from 5 to 9 horsepower, according to the speed, which varies from 900 to 1,200 r.p.m. on the main shaft and 300 to 600 r.p.m. on the back gear shaft. A special fly-ball governor gives close speed regulation.

There are large waterways around the cylinder valves to insure proper cooling. The engine is furnished for either radiator or tank cooling and also with the special Fuller & Johnson return circulation hopper. The engine has full pressure lubrication, with a simple oil-level gage.



A NEW TWO-CYLINDER GASOLINE ENGINE

Circular Steel Storage Bins

Interesting Installation in Seattle, Wash.

STEEL bins have been adopted as standard equipment by the Pioneer Sand and Gravel Company, Seattle, Wash., because it has been found that additional space is gained by this method of installation; dead storage is reduced; they are easy to operate; and there is a saving in labor, as the driver controls the delivery of the material from the bin to the truck without needing to leave his seat.

This plant of the Pioneer Sand and Gravel Company covers approximately 300 feet of water-front and is 400 feet deep. There is a circular railroad track laid around the plant. Scows come in from the sound and load alongside the docks, and the material is handled from the scows to the Blaw-Knox circular bins or to ground storage. The location of the bin is adjacent to its own ground storage, so that recharging operations are as efficient as possible. The locomotive crane used in handling material is a Link-Belt 25-ton crane equipped with a 1¼-yard Blaw-Knox Speedster bucket. The delivery of this plant at the present time is about 1,000 yards per day, exclusive of the central concrete-mixing plant. There are two circular steel bins of 85 tons capacity each, and four circular steel bins of 135 tons capacity each.

BATTERY OF SIX CIRCULAR BINS AT THE PIONEER SAND AND GRAVEL COMPANY'S SEATTLE PLANT

Contractor Rebuilds Shovel with New Power-Plant

Power Shovel Given New Lease of Life at Slight Cost

A FEW months ago the Taft Realty Company, of Los Angeles, contracted with the Miller-Burke Construction Company to do a lot of grading and excavation for them on one of their suburban developments. The Miller-Burke Company did not want to buy a new shovel and yet the engine in their old power shovel was worn out and would not stand up to the heavy job at hand. They called on the Los Angeles branch of the Climax Engineering Company, Clinton, Iowa, to help them out.

A CLOSE-UP OF THE REPAIR JOB

A thorough investigation showed that the old engine of the marine type was mounted on a cast iron base which also carried an outboard main bearing and idler gear bearings for the reduction gear. The space between the boom truss-rods was not quite long enough for the new engine as it stood, and various other things had to be done to put the Climax Model K engine in the cab. Altogether, it looked like a hopeless case, one of those jobs which contractors say "can't be done." Bids ranging from $500 to $1,000 were made by several machine rebuilders for mounting alone. The Climax Company took the job for $218, plus $86 for two new gears, in addition to the cost of the engine, and made a profit. The success of the job is shown by the fact that the operator snapped a steel cable the first time he put the shovel in the ground, without stalling the new Climax engine.

The details of the job are interesting because so many contractors think it does not pay to replace their old engines with new and better equipment. On the Miller-Burke job the heavy cast iron base was used by planing some metal off the top and adding two 3 x 3 x ½-inch steel angles to carry the new engine. The angles were left long enough to extend forward and carry the radiator also, and everything properly lined up with the outboard bearing at the rear. New pinions and idler gears were supplied and an extension added to the starting crank so that the engine could be started from outside the cab.

One of the most interesting things done was to change one of the boom truss rods in order to avoid the front cylinder of the engine. This is the rod shown near the radiator in the accompanying illustration. A piece was welded into this rod, a bend made to dodge the engine, and a brace made of 3-inch extra-heavy pipe, also showing in the photograph, placed between the bend and the floor alongside the engine. This holds the truss rod firm and gives plenty of room for the Climax engine.

By changing the engine, the Miller-Burke Company made money and avoided the necessity of buying a new shovel.

The Advantages of Steel Ties for Street Railway Tracks

A Type of Construction Rapidly Coming into General Use

DISTINCTLY new construction methods for renewable paved track in city streets have been developed by the International Steel Tie Company, Cleveland, Ohio, through the manufacture of its steel Twin Tie track.

The Twin Tie in its simplest form provides an effective bearing area when spaced at 6-foot intervals, equivalent to wood ties on 2-foot centers. With 7 inches of concrete below the base of the rail, these ties furnish the same effective bearing on the subgrade as wooden ties. A Twin Tie is a fabricated structural steel product made up of two 3-inch, 4-pound channels 6 feet, 2 inches long for standard gage, spaced 2 feet, 9 inches back to back and riveted together with two 5/16x13x36-inch steel plates. These plates are centered with the rail base so that equal bearing is provided on both sides. Each plate is provided with four punched holes for the rail fastenings, as well as four 1¼-inch diameter holes clearing the rail base and so spaced as to show whether the tamping has placed the ballast material in complete contact under the plate. When these ties are to be used in rock ballast the plates have their two longitudinal edges warped downward 2½ inches to form a tamping pocket beneath them and also to serve as

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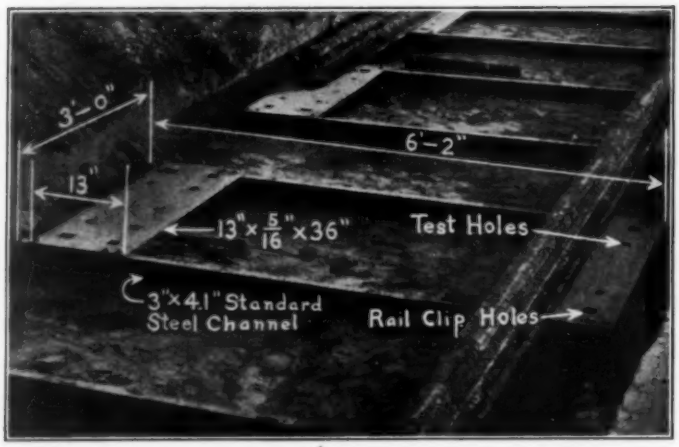


DETAILS OF STANDARD STEEL TWIN TIE

an anchorage in the ballast.

The requirements of an economical design for a steel tie are met most successfully by separating the two basic requirements—(1) a bearing surface on the ballast, and (2) a cross-member to hold the rails to gage, as is done by the Twin Tie principle. In the standard Twin Tie the bearing surfaces or plates take 63 per cent of the total tie weight, while the cross-members which hold the bearing surfaces to gage are 37 per cent of the total. This division, by making all the steel effective, results in the minimum weight per foot of track, which is the largest direct factor in the tie cost per foot of track. Nothing is sacrificed to the economic requirements in the design of these ties, for, as mentioned above, in the 6-foot spacing recommended a bearing area is provided equivalent to wooden ties on 2-foot centers. This bearing area is equal to 156 square inches per track foot, which exceeds the allowance on other steel tie track designs and is 10 times that necessary for a 25-ton car, figuring concrete in compression at 250 pounds per square inch.

An analysis of Twin Tie construction and wood tie construction shows that the former reduces the construction material 40 per cent, and still gives one inch more concrete in bearing. Furthermore, oak ties require a 9-foot trench, while the steel tie construction requires only a 7-foot trench. This also means a saving in labor costs which, with the use of only 880 Twin Ties per mile of track, as compared with 2,640 wooden ties, reduces the labor at least 50 per cent, according to the manufacturers. Twin Ties weigh 135 pounds and require two men to handle one tie, the same as a wooden tie. Being compact, the steel ties for more feet of track can be loaded on a car or stored in a given space than in the case of wooden ties. The reduction of the labor of laying track and the saving in concrete and excavation are economies that cannot well be overlooked in the extension or reconstruction of permanent tracks in paved streets. It will also be noted that less pavement area is disturbed when any reconstruction work is necessary, and this is an important item from the maintenance standpoint, both for the city and for the street railway.

TRACK EXTENSION USING STEEL TIES, WINSTON-SALEM, N. C.

New One-Half-Yard Full-Revolving Excavator

Machine Is Equipped with Crawler Traction for Gasoline or Electric Operation

A NEW ½-yard gasoline or electric machine mounted on Corduroy traction and known as Model 204 has been developed by the Harnischfeger Corporation, Milwaukee, Wis.

Power is supplied by a single gasoline motor of the heavy-duty tractor type, developing 46 horse-power at 900 r.p.m. All power is transmitted through cut steel gears with a minimum number of reductions. The two main drums are independently mounted on separate shafts and are controlled by outside band clutches and brakes, the clutches being operated by a power clutch control. The drums have a standard line speed of 110 feet per minute, but may be lagged to give higher speed for certain work. Both the revolving frame and the car body frame are of cast steel in one piece. All shafts are turned and ground to micrometer accuracy, and all bearings are provided with Alemite or pressure cup lubrication. The Corduroy frames are heavy steel castings which receive the weight of the machine from two heavy forged axles. The treads are non-cloggable and the tread rollers are swiveled in two directions to adjust to any irregularities of the ground. All gears are well guarded to protect the operator, and the first reduction and travel gears are fully enclosed running in oil. There are two travel speeds—11/16 and 1⅜ miles per hour forward and reverse. All steering is controlled from the operator's platform by use of a simple hand wheel. The main machinery and operator's platform are fully enclosed in an all-steel cab provided with suitable doors and windows for care and operation.

HALF-YARD FULL-REVOLVING SHOVEL IN ACTION

This machine handles a ½-yard dragline bucket on a 30-foot boom, or a ½-yard clamshell on a 35-foot boom, and has a rated lifting capacity of 13,000 pounds at a 10-foot radius, which is 75 per cent of its tipping capacity. The shovel is of ½-yard capacity and of standard P & H design, with an all-steel box-section boom, outside dipper sticks, and a crawling motion which enables the operator to have full control of the dipper at all points, acting independently of the hoisting.

A New Mortar for Wall Surfaces

Plastic Material Is Impervious to Water and Does Not Scale

A NEW mortar material for covering the exterior and interior surfaces of walls has been developed and is sold under the trade name "Walsment" by the Louisville Cement Company, Inc., Speed Building, Louisville, Ky. It is a plastic combination of cement which, when applied, according to the manufacturers, is practically impervious to water and may be employed in situations where other plasters are not efficient, for dampness does not cause it to scale or disintegrate.

When applied on metal lath to either the interior or the exterior of buildings, it forms a reinforced concrete covering which adds rigidity and which effects a saving of fuel by retaining the heat within the building. When applied to the interior walls, the surface is sufficiently hard so that it is not easily scarred, which makes it particularly well adapted for use in schools and other public buildings subjected to hard usage. When employed either in stucco or in interior plaster, Walsment lends itself to any kind of finish desired.

When mixed on the job with a specified amount of sand and water, Walsment is ready to apply. It may be applied to wood lath, metal lath, brick, tile, or concrete. For interior work it may be sand-finished, white-coated, troweled smooth for papering, or given a natural finish. On exterior work it can be applied in the same manner as portland cement stucco. Its natural color is a light tan, pleasing to the eye and harmonizing well with light-colored trim.

Unlike most other plasters and stuccoes, this material is not affected by age in storage, as it is claimed to lose no strength, nor will it become hard, as it does not absorb moisture from the air. It may be stored two years or longer without deterioration. It is packed in paper bags of 80 pounds each and in cloth sacks of 100 pounds each.

Smooth-Belt Conveyor Handles Mortar Successfully

60-Foot Conveyor Delivers Plaster into First Story Window of School Building

ON the Mitchel Junior High School at 32nd and Humboldt Streets, Denver, Colo., Henry & Feely, subcontractors, are using a Barber-Greene Type-N smooth-belt conveyor 18 inches wide and 60 feet long to carry plaster at an angle of 44 degrees up to and into the third story of the school building. This conveyor is actually working and discharges it into a large wooden hopper. On the third floor they have a small ¼-yard car on a narrow-gage track, into which the plaster is dumped from the hopper and in which it is taken to its destination. By this installation the plastering gang is cut from 15 to 3, who do all of the work previously handled by the larger number.

DELIVERING MIXED MORTAR TO A THIRD-STORY WINDOW BY PORTABLE CONVEYOR

at an angle of 44 degrees and handles the mixed plaster successfully.

The mortar or plaster is mixed in a Blystone mixer by one man operating and discharging it onto the belt of the conveyor, which in turn carries it to the inside of the building through a window

The conveyor is a standard Barber-Greene portable type N outfit mounted on a portable truck, and driven by a 15-horse-power Le Roi gasoline engine. P. J. Sullivan is the general contractor for the new Mitchel Junior High School at Denver.

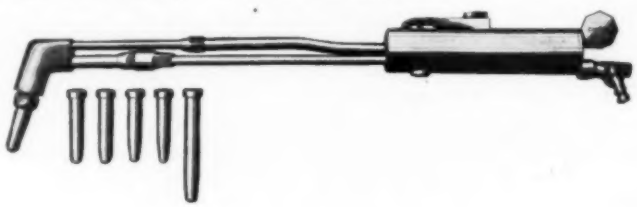
A New Low-Pressure Combination Cutting and Welding Torch

Acetylene Pressure Torch Made to Operate on Either Low or High Pressure Gases

A LOW-PRESSURE acetylene torch which will operate on low or high pressure gases with equal efficiency, has been developed by the Alexander Milburn Company, 1416-1428 West Baltimore Street. Baltimore. This torch is especially constructed to operate with low-pressure acetylene gas, city gas, or hydrogen, and can be used with a low-pressure acetylene generator. It is claimed that the torch is very efficient. It utilizes the highly specialized and standardized parts of the Milburn cutting and welding torches. It is built to insure a correct and intimate mixture of the oxygen and acetylene, resulting in a non-flashback quality.

The torch is adapted to perform welding as well as cutting work by the interchange of tips. It performs practically all the cutting and welding operations within range of the process. The torch is made up of bronze forgings and special seamless tubing, constructed to withstand constant service. The tops are made of solid copper and are interchangeable with a large number of low-pressure torches of other makes, which greatly increases their service.

THE NEW MILBURN HEATING AND WELDING TORCH WITH VARIOUS TIPS



Handling Grading Operations with a Wagon Loader

Material Prepared by Scarifier and Fresnos Quickly Handled by Mechanical Loader

THE Griffith Company, Los Angeles, Calif., is handling a large amount of road and street paving at the present time. The extent of its operations is indicated by the fact that the company has, within the last year and a half, purchased five new crawler traction pavers. In connection with some street paving in Santa Ana, Calif., about 30 miles from Los Angeles, they are using a Haiss creeper loader for grading work with satisfactory results.

The streets are 40 feet wide with a longitudinal joint along the center line, and one side of the street is being paved first and the second side graded and paved while the first side is being cured. The operation of grading consists of breaking up the ground with a scarifier drawn by mules, with some finishing work with picks. The scarified material is placed in windrows by "2-up" fresnos which are also drawn by mules. The windrowed material is loaded into Ford trucks with 1¼-yard bodies by the Haiss loader, which because of its easy adjustment can be held closely to grade. The grading foreman reported that they have many times loaded 1½ cubic yards of material into a Ford truck in 40 seconds.

HAISS LOADER WORKING ON GRADING JOB

An Interesting Western Bridge Job

UP-STREAM VIEW OF SHOSHONE RIVER BRIDGE, SHOWING FORM WORK FOR ARCH RIB IN PLACE

Photographs by courtesy of D. R. Petrie Northwest Equipment Company, Inc., Billings, Mont.

ABUTMENT AND PLANT LAYOUT FOR SHOSHONE RIVER BRIDGE AT CODY, WYO.

The old road passes near the house in the upper right-hand corner. Koehring Dandie 107-S Mixer shown chuting concrete for arch rib spandrels

Distributors of Contractors' Equipment

THE following cards (arranged by states) show the names of dealers in contractors' equipment and supplies with a record of the various lines handled. Contractors will find this list a convenient means of getting in touch with dealers who make a point of giving satisfactory service and prompt shipments. This directory is constantly consulted by our subscribers and any suggestions regarding it will be welcomed.

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